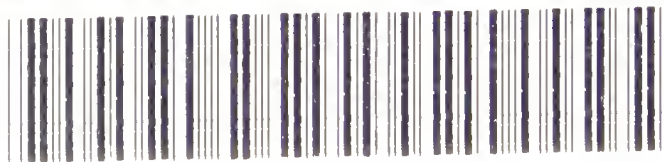


VEGETABLE
MATERIA MEDICA

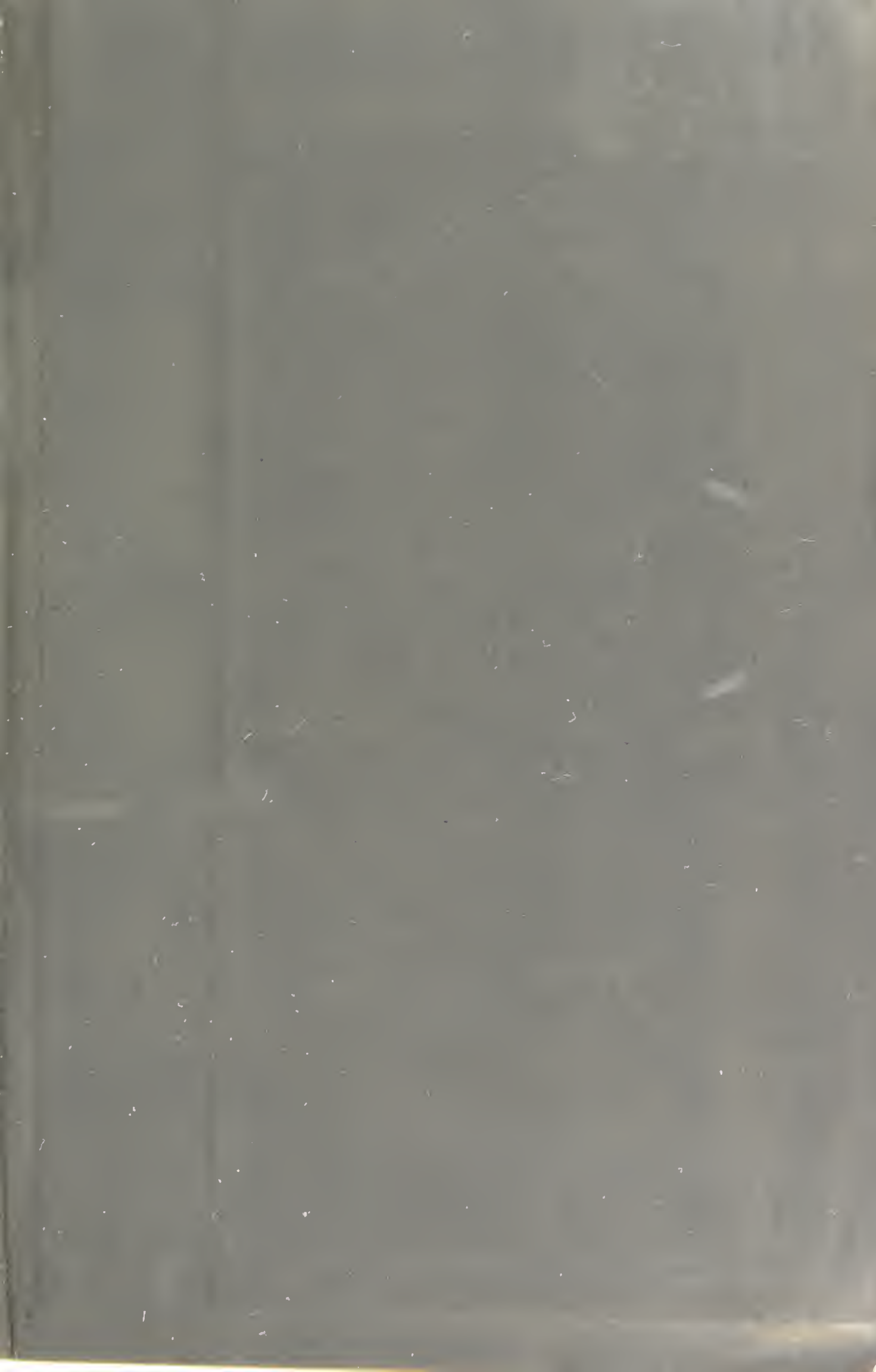
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A M A N U A L
OF
VEGETABLE MATERIA MEDICA,
WITH NUMEROUS ILLUSTRATIONS AND WOODCUTS,

BY
G. S. V. WILLS, F.L.S., F.R.M.S., &c.

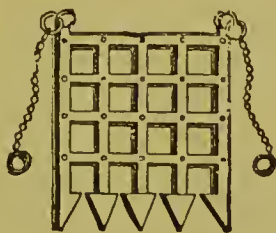
ANALYTICAL AND CONSULTING CHEMIST.

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MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY, &c.



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ELEVENTH EDITION.

PRICE 10s. 6d.

LONDON :

SIMPKIN, MARSHALL & Co.

AND AT THE OFFICE OF THE COLLEGE, TRINITY SQUARE, BOROUGH,
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1889.

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P R E F A C E.

IN issuing a new and enlarged edition of this manual, care has been taken to include as much matter as possible which is requisite for the use of Students, for whom this manual is particularly intended, without entering too much into detail. The introduction of most of the new matter, particularly that part dealing with the constituents of drugs, becomes a necessity when the more recent and rapid advance of the knowledge of plant analysis is taken into consideration. The characteristic reactions with chemical reagents of the alkaloids and other closely allied bodies have in many cases been included.

The work is rendered more particularly useful by containing the following special features:—

1.—A tabulated list of drugs, with the natural orders, botanical names, the parts used, and all the preparations into which they enter.

2.—A map of the world, by reference to which the habitat of a drug, and the geographical position of that habitat, may be ascertained in a few moments.

3.—100 Coloured Illustrations and numerous woodcuts of the most important Barks, Roots, Leaves, Gums, &c., showing their principal characteristics.

4.—A short descriptive method of the processes employed in the extraction of most plant constituents, and the means adopted for their examination.

5.—The percentages of the different alkaloids, active principles, oils, gums, resins, &c., conveniently tabulated.

6.—Table of the various fruits.

7.—The numbers preceding the names of the drugs refer to the numbered specimens in the *Materia Medica Museum* at the *Westminster College of Chemistry and Pharmacy*.

The Therapeutical portion of the manual is reduced to a minimum, as that is more properly the work of the Medical lecturer.

For much of the information the author is largely indebted to many scientific and technical works, amongst them being Dragendorff's "*Plant Analysis*," "*The Pharmacographia*," "*The National Dispensatory*," "*The Pharmaceutical Journal*," and the "*Journal of the Chemical Society*."

He also desires to record the obligation he is under to his Assistant, Mr. W. WATSON WILL, who has ably and cheerfully rendered him much valuable aid.

Westminster College,
April, 1889.

NAMES.	PARTS USED.	BOTANICAL SOURCES.
Acacia	The gum which exudes from the stem and branches	Acacia Senegal and other species of Acacia
Aconite Leaves ...	Fresh leaves and flowering tops	Aconitum Napellus
Aconite Root ...	The dried root	Aconitum Napellus
Aloe Barbadensis	Inspissated juice of the leaf	Aloe vulgaris
Aloe Socotrinæ ...	Inspissated juice of the leaf	Aloe Perryi and probably other species
Ammoniacum ...	Gum-resinous exudation from the stem	Dorema Ammoniacum ...
Amygdala Amara	The oil	Prunus Amygdalus
Amygdala Dulcis	Seed and oil	Prunus Amygdalus
Amylum	Starch	Triticum Sativum ; Zea Mays ; Oryza Sativa
Anethi Fructus ...	Dried fruit	Peucedanum graveolens ...
Anisi Fructus ...	The oil	Pimpinella Anisum
Anisi Stellati Fructus	The oil	Illicium Anisatum
Anthemidis Flores	Dried single and double flower heads	Anthemis nobilis
Armoraciæ Radix	Fresh root... ..	Cochlearia Armoracia... ..
Arniciæ Rhizoma	Dried rhizome and rootlets	Arnica Montana
Asafœtida	Gum-resin... ..	Ferula Narthex and other species
Aurantii Flores...	Flowers	Citrus vulgaris... ..

NATURAL ORDERS.	HABITATS.	OFFICIAL PREPARATIONS.
Leguminosæ ...	Eastern Africa ...	Mist. Cretæ ; Mist. Guaiaci ; Mucil. Acaciæ ; Pulv. Amygdalæ Co. ; Pulv. Tragacanth Co., and in all the Trochisci.
Ranunculaceæ ...	Britain & Germany	Ext. Aconiti.
Ranunculaceæ ...	Britain & Germany	Aconitina ; Lin. Aconiti, and Tinct. Aconiti.
Liliaceæ ...	Barbadoes...	Aloin ; Enema Aloes ; Ext. Aloes Barb. ; Pil. Aloes Barb. ; Pil. Aloes et Ferri ; Pil. Cambogiæ Co. ; Pil. Colocynthis et Hyoscyami.
Liliaceæ ...	Socotra ...	Aloin ; Dec. Aloes Co. ; Enema Aloes ; Ext. Aloes Soc. ; Ext. Colo. Co. ; Pil. Aloes et Asafoetidæ ; Pil. Aloes et Myrrhæ ; Pil. Aloes Soc. ; Pil. Rhei Co. ; Tinct. Aloes ; Tinct. Benzoini Co. ; Vin. Aloes.
Umbelliferæ ...	Persia and the Punjaub	Emp. Ammoniaci cum Hydrargyro ; Emp. Galbani ; Mist. Ammoniaci ; Pil. Scillæ Co. ; Pil. Ipecac. cum Scilla.
Rosaceæ ...	Mogadore ...	Ol. Phosphoratum ; Ung. Cetacei ; Ung. Simplex ; Ung. Resinæ.
Rosaceæ ...	Malaga ...	Ol. Amygdalæ ; Pulv. Amygdalæ Co. ; Mist. Amygdalæ.
Graminaceæ ...	— —	Glycerinum Amyli ; Mucil. Amyli ; Pulv. Tragacanthæ Co. ; Sup. Acid. Tannici cum Sapone ; Sup. Morphinae cum Sapone.
Umbelliferæ ...	Great Britain and South Europe	Aq. Anethi ; Ol. Anethi.
Umbelliferæ ...	Malta, Spain, Egypt and Germany	Ess. Anisi ; Aq. Anisi ; Ol. Anisi ; Tinct. Camph. Co. ; Tinct. Opii Ammoniata.
Magnoliaceæ ...	China ...	— —
Compositæ ...	Indigenous ...	Ext. Anthemidis ; Inf. Anthemidis ; Ol. Anthemidis.
Cruciferae ...	Great Britain ...	Sp. Armoraciæ Co.
Compositæ ...	Central and South Europe	Tinct. Arnicae.
Umbelliferæ ...	Afghanistan and Punjaub	Enema Asafoetidæ ; Pil. Aloes et Asafoetidæ ; Pil. Asafoetidæ Co. ; Sp. Ammoniac Foetidus ; Tinct. Asafoetidæ.
Aurantiaceæ ...	South Europe ...	Aq. Aurantii Floris.

NAMES.	PARTS USED.	BOTANICAL NAMES.
Aurantii Cortex ..	The dried outer bark of the rind or pericarp	<i>Citrus vulgaris</i>
Aurantii Fructus	The ripe fruit	<i>Citrus vulgaris</i>
Balsamum Peruvianum	The balsam	<i>Myroxylon Pereiræ</i>
Balsamum Tolutanum	The balsam	<i>Myroxylon Toluifera</i>
Belæ Fructus ...	The dried half-ripe fruit...	<i>Ægle Marmelos</i>
Belladonnæ Folia	Fresh leaves and young branches	<i>Atropa Belladonna</i>
Belladonnæ Radix	Dried root... ..	<i>Atropa Belladonna</i>
Benzoinum ...	Balsamic resin	<i>Styrax Benzoin</i> and other species
Buchu Folia ...	Dried leaves	<i>Barosma betulina</i> ; <i>B. crenulata</i> ; <i>B. serratifolia</i>
Calumbæ Radix ...	The dried root	<i>Jateorhiza Calumba</i>
Cambogia	Gum-resin... ..	<i>Garcinia Hanburii</i>
Camphora	A stearoptene	<i>Cinnamomum Camphora</i> ..
Canellæ Cortex ...	The bark deprived of its corky layer and dried	<i>Canella alba</i>
Cannabis Indica	The dried flowering or fruiting tops of the female plants	<i>Cannabis sativa</i>
Capsici Fructus ...	The dried ripe fruit	<i>Capsicum fastigiatum</i>
Cardamomi Semina	The dried ripe seeds	<i>Elettaria Cardamomum</i>
Carui Fructus ...	The dried fruit	<i>Carum Carui</i>
Caryophyllum ...	The dried flower bud	<i>Eugenia caryophyllata</i>

NATURAL ORDERS.	HABITATS.	OFFICIAL PREPARATIONS.
Aurantiaceæ ...	South Europe ...	Inf. Aurantii ; Inf. Aurantii Co. ; Inf. Gentianæ Co. ; Sp. Armoraciæ Co. ; Tinct. Aurantii ; Tinct. Cin- chonæ Co. ; Tinct. Gentianæ Co.
Aurantiaceæ ...	South Europe ...	Tinct. Aurantii Recentis.
Leguminosæ ...	Salvador ...	— —
Leguminosæ ...	New Granada ...	Pil. Phosphori ; Syr. Tolutanus ; Tinct. Benzoini Co. ; Tinct. Tolutana.
Aurantiaceæ ...	Malabar and Coro- mandel	Ext. Bellæ Liquidum.
Solanaceæ ...	Great Britain and Germany	Ext. Belladonnæ ; Succus Bella- donnæ from leaves and branches ; Tinct. Belladonnæ from leaves only.
Solanaceæ ...	Great Britain and Germany	Atropina ; Lin. Belladonnæ ; Ext. Belladonnæ Alcoholicum.
Styraceæ ...	Siam and Sumatra	Acid. Benzoicum ; Adeps Benzoatus ; Tinct. Benzoini Co. ; Ung. Cetacei.
Rutaceæ ...	Cape of Good Hope	Inf. Buchu ; Tinct. Buchu.
Menispermaceæ ...	Ibo and Zambesi ...	Ext. Calumbæ ; Inf. Calumbæ ; Mist. Ferri Aromatica ; Tinct. Calumbæ.
Guttiferæ ...	Siam ...	Pil. Cambogiæ Co.
Lauraceæ ...	China and Japan...	Aq. Camphoræ ; Lin. Aconiti ; Lin. Belladonnæ ; Lin. Camphoræ ; Lin. Camph. Co. ; Sp. Camphoræ ; Tinct. Camph. Co. ; Ung. Hydrarg. Co. ; Lin. Chloroform. Co. ; Lin. Hydrar- gyri ; Lin. Opii ; Lin. Saponis ; Lin. Sinapis Co. ; Lin. Terebinthinæ ; Lin. Terebinthinæ Aceticum.
Canellaceæ ...	West Indies ...	Vinum Rhei.
Cannabinaceæ ...	India ...	Ext. Cannabis Indicæ ; Tinct. Canna- bis Indicæ.
Solanaceæ ...	Zanzibar ...	Tinctura Capsici.
Zingiberaceæ ...	Malabar ...	Ext. Coloc. Co. ; Pulv. Cinnam. Co. ; Pulv. Cretæ Aromat ; Tinct. Card. Co. ; Tinct. Gentian. Co. ; Tinct. Rhei ; Vin. Aloes.
Umbelliferæ ...	England & Germany	Aq. Carui ; Conf. Opii ; Conf. Piperis ; Ol. Carui ; Pulv. Opii Co. ; Tinct. Card. Co. ; Tinct. Sennæ.
Myrtaceæ ...	Penang & Bencoolen	Inf. Aurantii Co. ; Inf. Caryophylli ; Mist. Ferri Aromatica ; Ol. Caryo- phylli ; Vin. Opii.

NAMES.	PARTS USED.	BOTANICAL NAMES.
Cascarillæ Cortex	Dried bark	Croton Eluteria
Cassiæ Pulpa ...	Pulp obtained from the pods	Cassia Fistula
Catechu	An extract of the leaves and young shoots	Uncaria Gambier
Cerevisiæ Fermentum	Ordinary yeast	Saccharomyces Cerevisiæ ...
Cetraria	The dried lichen	Cetraria Islandica
Chirata	The dried plant	Ophelia Chirata
Chrysarobinum ...	The medullary matter of the stem and branches	Andira Araroba
Cimicifugæ Rhizoma	The dried rhizome and rootlets	Cimicifuga Racemosa
Cinchonæ Cortex	Dried bark	Cinchona Calisaya ; C. Succirubra ; C. lancifolia
Cinchonæ Rubræ Cortex	Dried bark of the stem and branches of cultivated plants	Cinchona Succirubra
Cinnamomi Cortex	The dried inner bark, the shoots from the truncated stock or stools of the cultivated trees	Cinnamomum Zeylanicum ...
Coca	Dried leaves	Erythroxylon Coca
Colchici Cormus...	Fresh and dried corm ...	Colchicum autumnale
Colchici Semina ...	Ripe seeds... ..	Colchicum autumnale
Colocynthis Pulpa	Dried peeled fruit freed from the seeds	Citrullus Colcynthis
Conii Folia ...	The fresh leaves and young branches	Conium maculatum
Conii Fructus ...	Dried fruit	Conium maculatum
Copaiba	Oleo-resin... ..	Copaifera Langsdorffii and other species
Coriandri Fructus	Dried ripe fruit	Coriandrum sativum
Crocus	The dried stigma and top of the style	Crocus sativus

NATURAL ORDERS.	HABITATS.	OFFICIAL PREPARATIONS.
Euphorbiaceæ ... Leguminosæ ...	Bahama Islands ... East & West Indies	Inf. Cascarillæ ; Tinct. Cascarillæ. Confectio Sennæ.
Cinchonaceæ ... Fungi ...	Singapore ... — —	Inf. Catechu ; Pulv. Catechu Co. ; Tinct. Catechu ; Trochisci Catechu. Cataplasma Fermenti.
Lichens ... Gentianaceæ ... Leguminosæ ...	North Europe ... North India ... India ...	Decoctum Cetrariæ. Inf. Chiratæ ; Tinct. Chiratæ. Unguentum Chrysarobini.
Ranunculaceæ ...	North America ..	Ext. Cimicifugæ Liq. ; Tinct. Cimicifugæ
Cinchonaceæ ...	(Calisaya) Bolivia & S. Peru ; (Lancifolia) New Granada ; (Pallida) Loxa in Ecuador	Cinchonidinæ Sulph. ; Cinchoninæ Sulph. ; Quininæ Hydrochlor. ; Quininæ Sulph.
Cinchonaceæ ...	W. Chimborazo and India	Dec. Cinchonæ ; Ext. Cinch. Liq. ; Inf. Cinch. Acid. ; Mist. Ferri Arom. ; Tinct. Cinchonæ ; Tinct. Cinch. Co.
Lauraceæ ...	Ceylon ...	Acid. Sulph. Aromat. ; Aq. Cinnam. ; Dec. Hæmatoxyli ; Inf. Catechu ; Ol. Cinnam. ; Pulv. Catechu Co. ; Pulv. Cinnam. Co. ; Pulv. Cretæ Aromat. ; Pulv. Kino Co. ; Tinct. Card. Co. ; Tinct. Catechu ; Tinct. Cinnam. ; Tinct. Lavandulæ Co. ; Vin. Opii.
Erythroxylaceæ ... Melanthaceæ ...	Bolivia and Peru ... Indigenous ...	Ext. Cocæ Liq. ; Cocainæ Hydrochlor. Ext. Colchici ; Ext. Colch. Aceticum ; Vin. Colchici.
Melanthaceæ ... Cucurbitaceæ ...	Indigenous ... Smyrna, Trieste, France and Spain	Tinctura Colchici Seminum. Ext. Coloc. Co. ; Pil. Coloc. Co. ; Pil. Coloc. et Hyoscyami.
Umbelliferæ ...	Indigenous ...	Ext. Conii ; Succus Conii.
Umbelliferæ ... Leguminosæ ...	Indigenous ... Banks of Amazon	Tinctura Conii. Oleum Copaibæ.
Umbelliferæ ...	Great Britain ...	Conf. Sennæ ; Ol. Coriandri ; Syr. Rhei ; Tinct. Rhei ; Tinct. Sennæ.
Iridaceæ ...	Spain, France, and Italy	Dec. Aloes Co. ; Pil. Aloes et Myrrhæ ; Pulv. Cretæ Aromat. ; Tinct. Cinchon. Co. ; Tinct. Croci ; Tinct. Opii Ammon. ; Tinct. Rhei.

NAMES.	PARTS USED.	BOTANICAL NAMES.
Crotonis Oleum ...	Oil from the seeds ...	Croton Tiglium ...
Cubeba ...	Dried unripe full grown fruits	Piper Cubeba ...
Cuspariæ Cortex	Dried bark ...	Galipea Cusparia ...
Cusso ...	Dried panicles chiefly of the female flowers	Hagenia Abyssinica ...
Digitalis Folia ...	The leaf carefully dried...	Digitalis purpurea ...
Dulcamara ...	Young stem and branches	Solanum Dulcamara ...
Ecballii Fructus...	The fruit very nearly ripe	Ecballium Elaterium ...
Elemi ...	A concrete resinous exudation	Canarium commune (probably)
Ergota ...	The sclerotium, produced between the pale of the common Rye and replacing the grain	Claviceps purpurea ...
Eucalypti Oleum	Oil distilled from the leaves	Eucalyptus Globulus; Eucalyptus Amygdalina
Farina Tritici ...	The grain of wheat ground and sifted	Triticum sativum ...
Ficus ...	Dried fruit ...	Ficus Carica ...
Filix Mas...	Dried rhizome with the persistent bases of the petioles	Aspidium Filix-mas ...
Fœniculi Fructus	The dried fruit of cultivated plants	Fœniculum Capillaceum ...
Galbanum...	Gum-resin...	Ferula Galbaniflua ; F. Rubri-caulis ; and probably other species
Galla ...	Excrescences caused by the puncture and deposit of an egg of Cynips Gallæ tinctoriæ	Quercus lusitanica ...
Gelsemium ...	Dried rhizome and rootlets	Gelsemium nitidum ...
Gentianæ Radix...	Dried root...	Gentiana lutea...
Glycyrrhizæ Radix	Root and subterranean stem or stolon, fresh and dried	Glycyrrhiza glabra ...
Gossypium ...	Hairs of the seed ..	Gossypium barbadense and other species
Granati Radicis Cortex	Dried bark of the root ...	Punica Granatum ...
Guaiaci Lignum...	Heart-wood reduced to chips	Guaiacum officinale or G. sanctum

NATURAL ORDERS.	HABITATS.	OFFICIAL PREPARATIONS.
Euphorbiaceæ ...	Ceylon ...	Oil.
Piperaceæ ...	Java ...	Oleo-resin Cubebæ ; Ol. Cubebæ ; Tinct. Cubebæ.
Rutaceæ ...	South America ...	Infusum Cuspariæ.
Rosaceæ ...	Abyssini ...	Infusum Cusso.
Scrophulariaceæ	Indigenous ...	Inf. Digitalis ; Tinct. Digitalis.
Solanaceæ ...	Indigenous ...	— —
Cucurbitaceæ ...	Indigenous ...	Elaterium.
Amyridaceæ ...	Manilla ...	Unguentum Elemi.
Fungi ...	Spain ...	Ext. Ergotæ Liq. ; Inf. Ergotæ ; Tinct. Ergotæ.
Myrtaceæ ...	Australia and Tas- mania	Oil.
Graminaceæ ...	Indigenous ...	Cataplasma Ferment.
Artocarpaceæ ...	Smyrna ...	Confectio Sennæ.
Filices ...	Indigenous ...	Extractum Filicis Liquidum.
Umbelliferæ ...	Malta ...	Aq. Fœniculi ; Pulv. Glycyrrhizæ Co.
Umbelliferæ ...	Persia ...	Emp. Galbani ; Pil. Asafœtidæ Co.
Cupuliferæ ...	Asia Minor and Greece	Acid. Gallicum ; Acid. Tannicum ; Tinct. Gallæ ; Ung. Gallæ ; Ung. Gallæ cum Opio.
Loganiaceæ ...	Southern States of North America	Ext. Gelsemii Alcoholicum ; Tinct. Gelsemii.
Gentianaceæ ...	Central and South Europe	Ext. Gentianæ ; Inf. Gentianæ Co. ; Tinct. Gentianæ Co.
Leguminosæ ...	Great Britain ...	Conf. Terebinthinæ ; Dec. Sarsæ Co. ; Ext. Glycyrrhizæ ; Ext. Glycyrrhizæ Liq. ; Inf. Lini. ; Pil. Hydrarg. ; Pil. Ferri Iodidi ; Pulv. Glycyrrhizæ Co.
Malvaceæ ...	Egypt, India and America	Pyroxylin.
Myrtaceæ ...	South Europe ...	Dec. Granati Radicis.
Zygophyllaceæ ...	St. Domingo and Jamaica	Dec. Sarsæ Co.

NAMES.	PARTS USED.	BOTANICAL NAMES.
Guaiaci Resina ...	Resin	Guaiacum officinale or G. sanctum
Gutta Percha ...	Concrete juice	Dichopsis Gutta and several other trees of the same natural order
Hæmatoxyli Lignum	Sliced heart-wood	Hæmatoxylum Campechianum
Hemidesmi Radix	Dried root... ..	Hemidesmus indicus
Hordeum Decor- ticatum	Dried seed, deprived of its integuments	Hordeum distichon
Hyoscyami Folia	Leaves and flowers, with or without branches	Hyoscyamus niger
Ipecacuanha ...	Dried root	Cephaëlis Ipecacuanha
Jaborandi... ..	Dried leaflets	Pilocarpus pennatifolius
Jalapa	Dried tubercles	Ipomæa purga
Juniper	Oil from the unripe fruit...	Juniperus communis
Kamala	A powder which consists of the minute glands and hairs obtained from the surface of the fruits	Mallotus philippinensis
Kino	Juice from the trunk inspissated	Pterocarpus marsupium
Krameriaë Radix	Dried root... ..	Krameria triandria, K. Ixina...
Lactuca	Flowering herb	Lactuca virosa
Laricis Cortex ...	Dried inner bark	Pinus Larix
Laurocerasi Folia	Fresh leaves	Prunus Laurocerasus
Lavandulæ Oleum	Flowers	Lavandula vera
Limonis Cortex {	The outer part of the rind or pericarp of the fresh fruit, and juice	Citrus Limonum
„ Succus {		
Lini Semina ...	Seeds reduced to powder	Linum usitatissimum
Lobelia	Dried flowering herb ...	Lobelia inflata
Lupulus	Dried strobiles	Humulus Lupulus
Manna	Concrete saccharine exudation from the stem	Fraxinus Ornus

NATURAL ORDERS.	HABITATS.	OFFICIAL PREPARATIONS.
Zygophyllaceæ ...	St. Domingo and Jamaica	Mist. Guaiaci ; Pil. Hyd. Subchlor. Co. ; Tinct. Guaiaci Ammoniata.
Sapotaceæ ...	South India, Ceylon. Sumatra, and Borneo	Liquor Gutta Percha.
Leguminosæ ...	Campeachy ...	Dec. Hæmatoxyli ; Ext. Hæmatoxyli.
Asclepiadaceæ ...	India ...	Syrupus Hemidesmi.
Graminaceæ ...	Great Britain ...	Decoctum Hordei.
Solanaceæ ...	Indigenous ...	Ext. Hyoscyami ; Succus Hyoscyami ; Tinctura Hyoscyami.
Rubiaceæ ...	Brazil ...	Pil. Conii Co. ; Pil. Ipecac. cum Scilla ; Pulv. Ipecac. cum Scilla ; Pulv. Ipecac. Co. ; Trochisci Ipe- cacuanhæ ; Trochisci Morphinae et Ipecac. ; Vin. Ipecac.
Rutaceæ ...	Pernambuco ...	Ext. Jaborandi ; Inf. Jaborandi.
Convolvulaceæ ...	Mexico ...	Ext. Jalapæ ; Pulv. Jalapæ Co. ; Pulv. Scam. Co. ; Resina Jalapæ ; Tinct. Jalapæ.
Coniferæ ...	Europe ...	Oleum Juniperi ; Spiritus Juniperi.
Euphorbiaceæ ...	India ...	— —
Leguminosæ ...	Malabar ...	Pulv. Catechu Co. ; Pulv. Kino Co. ; Tinct. Kino.
Polygalaceæ ...	Peru ...	Ext. Krameriaë ; Inf. Krameriaë ; Pulv. Catechu Co. ; Tinct. Krameriaë.
Compositæ ...	Great Britain ...	Extractum Lactucæ.
Coniferæ ...	Central Europe ...	Tinctura Laricis.
Rosaceæ ...	England ...	Aqua Laurocerasi.
Labiataë ...	England ...	Lin. Camph. Co. ; Sp. Lavandulæ ; Tinct. Lavandulæ Co.
Aurantiaçææ ...	South Europe ...	Inf. Aurantii Co. ; Inf. Gent. Co. ; Ol. Limonis ; Syr. Limonis ; Tinct. Limonis ; Succus Limonis.
Linaceæ ...	Great Britain ...	Farina Lini ; Inf. Lini ; Ol. Lini.
Lobeliaceæ ...	North America ...	Tinct. Lobeliaë ; Tinct. Lobeliaë Ætherea.
Cannabinaceæ ...	Great Britain ...	Ext. Lupuli ; Inf. Lupuli ; Tinct. Lupuli.
Oleaceæ ...	Calabria and Sicily	— —

NAMES.	PARTS USED.	BOTANICAL NAMES.
Mastiche ...	Concrete resinous exuda- tion from the stem and large branches	Pistacia Lentiscus ...
Maticæ Folia ...	Dried leaves ...	Piper angustifolium ...
Mentha piperita (oleum)	Oil... ..	Mentha piperita ...
Mentha viridis (oleum)	Oil... ..	Mentha viridis... ..
Menthol ...	Stearoptene obtained from the oil	Mentha arvensis, Mentha piperita
Mezerei Cortex ...	Dried bark ...	Daphne Mezereum, and Lau- reola
Mica Panis ...	Crumb of bread made of wheaten flour	Triticum sativum ...
Morus ...	Juice of the ripe fruit ...	Morus nigra
Myristica ...	Dried seed divested of its hard coat or shell	Myristica fragrans ...
Myrrha ...	Gum resin... ..	Balsamodendron Myrrha ...
Nectandræ Cortex	Dried bark ...	Nectandra Rodieæi ...
Nux Vomica ...	Seeds ...	Strychnos Nux-vomica ...
Olivæ Oleum ...	Oil obtained from the ripe fruit	Olea Europæa ...
Opium ...	Inspissated juice from the unripe capsules	Papaver somniferum ..
Papaveris Cap- sulæ	Nearly ripe capsules, dried	Papaver somniferum ...
Pareiræ Radix ...	Dried root... ..	Chondrodendron tomentosum ..
Physostigmatis Semen	Dried seeds ...	Physostigma venenosum ...
Pimenta ...	Dried unripe full-grown fruits	Pimenta officinalis ...
Piper nigrum ...	Dried unripe fruits ...	Piper nigrum ...
Pix Burgundicæ...	Resinous exudation from the stem	Pinus Picea ...
Pix Liquida ...	Bituminous liquid ob- tained from the wood	Pinus sylvestris and other species
Podophyllum Rhizoma	Dried rhizome and rootlets	Podophyllum Peltatum ...

NATURAL ORDERS.	HABITATS.	OFFICIAL PREPARATIONS.
Anacardiaceæ ...	Scio and the Levant	— —
Piperaceæ ...	Peru ...	Infusum Maticæ.
Labiataæ ...	Indigenous ...	Aq. Menthæ Piperitæ ; Ess. Menth. Pip. ; Pil. Rhei Co. ; Sq. Menthæ Piperitæ ; Tinct. Chloroformi et Morphinæ.
Labiataæ ...	Indigenous ...	Aq. Menthæ Viridis.
Labiataæ ...	Japan and China...	— —
Thymelaceæ ...	Indigenous ...	Dec. Sarsæ Co. ; Ext. Mezerei Æthereum.
Graminaceæ ...	— —	Cataplasma Carbonis.
Moraceæ ...	Asia Minor ...	— —
Myristicaceæ ...	Banda Island ...	Ol. Myristicæ et Expressum ; Pulv. Catechu Co. ; Pulv. Cretæ Aromaticus ; Sp. Armoraciæ Co. ; Tinct. Lavandulæ Co.
Amyridaceæ ..	Arabia Felix and Abyssinia	Dec. Aloes Co. ; Mist. Ferri Co. ; Pil. Aloes et Myrrhæ ; Pil. Asafoetidæ Co. ; Pil. Rhei Co. ; Tinct. Myrrhæ.
Lauraceæ ...	British Guiana ...	Beberinæ Sulphas.
Loganiaceæ ...	East Indies and Ceylon	Ext. Nucis Vomicae ; Stychnina ; Tinct. Nucis Vomicae.
Oleaceæ ...	S. Europe ...	Emplastra, Linimenta, and Unguenta ; Charta Epispastica ; Enema Mag. Sulph.
Papaveraceæ ...	Asia Minor ...	Numerous preparations.
Papaveraceæ ...	Great Britain ...	Dec. Papaveris ; Ext. Papaveris ; Syr. Papaveris.
Menispermaceæ ...	Brazil ...	Dec. Pareiræ ; Ext. Pareiræ.
Leguminosæ ...	West Africa ...	Extractum Physostigmatis.
Myrtaceæ ...	West Indies ...	Aq. Pimentæ ; Ol. Pimentæ.
Piperaceæ ...	East Indies ...	Conf. Opii ; Conf. Piperis ; Pulvis Opii Co.
Coniferæ ...	Switzerland ...	Emp. Ferri ; Emp. Picis.
Coniferæ ...	Russia, Finland and Sweden	Unguentum Picis liquidæ.
Berberidaceæ ...	N. America ...	Resina Podophylli.

NAMES.	PARTS USED.	BOTANICAL NAMES.
Prunum	Dried fruit	Prunus domestica
Pterocarpi Lignum	Heart wood	Pterocarpus santalinus ..
Pyrethri Radix ...	Dried root... ..	Anacyclus Pyrethrum
Quassia Lignum	Chips, shavings, or rasp- ings of the wood	Picraena excelsa
Quercus Cortex ...	Dried bark of small branches and young stems	Quercus Robur... ..
Resina	The residue left after the distillation of oil of tur- pentine from the crude oleo-resin	Various species of Pines ...
Rhamni Frangulae Cortex	Dried bark	Rhamnus Frangula
Rhamnus Pursh- iani	Dried bark	Rhamnus Purshianus
Rhei Radix	Dried root more or less de- prived of its bark	Rheum palmatum, R. officinale, and other species
Rhæados Petala...	Fresh petals	Papaver Rhœas
Ricini (oleum) ...	Oil expressed from the seeds	Ricinus communis
Rosæ Caninæ Fructus	Ripe fruits	Rosa canina, and other in- digenous allied species
Rosæ Centifoliae Petala	Fresh fully expanded petals	Rosa centifolia
Rosæ Gallicæ Pet- ala	Fresh and dried unex- panded petals	Rosa Gallica
Rosmarini (oleum)	Oil distilled from the flowering tops	Rosmarinus officinalis...
Rutæ (oleum) ...	Oil distilled from the herb	Ruta graveolens
Sabadilla	Dried ripe seeds freed from their pericarps	Schœnocaulon officinale ...
Sabinæ Cacumina	Fresh and dried tops ...	Juniperus Sabina
Saccharum Puri- ficatum	Juice from the stem ...	Saccharum officinarum ...

NATURAL ORDERS.	HABITATS.	OFFICIAL PREPARATIONS.
Rosaceæ ...	S. Europe ...	Confectio Sennæ.
Leguminosæ ...	Ceylon and Coromandel	Tinctura Lavandulæ Co.
Compositæ ...	Spain and Africa...	Tinctura Pyrethri.
Simarubaceæ ...	Jamaica ...	Ext. Quassiae ; Inf. Quassiae ; Tinct. Quassiae.
Cupuliferæ ...	Great Britain ...	Decoctum Quercus.
Coniferæ ...	N. America and France	Charta Epispastica ; Ung. Terebinthinæ ; Unguentæ Resinæ, Calefaciens. Cantharidis, Picis, Plumb. Iodidi, Saponis.
Rhamnaceæ ...	Europe ...	Ext. Rhamni Frangulæ ; Ext. Rhamni Frangulæ Liq.
Rhamnaceæ ...	N. America ...	Ext. Cascaræ Sagradæ et Liquidum.
Polygonaceæ ...	China, C. Tartary and Thibet	Ext. Rhei ; Inf. Rhei ; Pil. Rhei Co. ; Pulv. Rhei Co. ; Syr. Rhei ; Tinct. Rhei ; Vin. Rhei.
Papaveraceæ ...	Great Britain ...	Syrupus Rhæados.
Euphorbiaceæ ...	S. Asia. Egypt. Italy and United States	Collodium Flexile ; Lin. Sinapis Co. ; Pil. Hyd. Subchlor. Co.
Rosaceæ ...	Great Britain ...	Confectio Rosæ Caninæ.
Rosaceæ ...	Great Britain ...	Aqua Rosæ.
Rosaceæ ...	Great Britain ...	Conf. Rosæ Gallicæ ; Inf. Rosæ Acidum ; Syr. Rosæ Gallicæ.
Labiatae ...	S. Europe and Asia Minor	Lin. Saponis ; Sp. Rosmarini ; Tinct. Lavandulæ Co.
Rutaceæ ...	England ...	—
Melanthaceæ ...	Mexico ...	Veratrina.
Coniferæ ...	Great Britain ...	Ol. Sabinæ ; Tinct. Sabinæ ; Ung. Sabinæ.
Graminaceæ ...	West Indies ...	Conf. Rosæ Caninæ, Gallicæ, and Sennæ ; Ext. Sarsæ Liquidum ; Ferri Carb. Sac. ; Liq. Calcis Sac. ; Mist. Ferri Co. ; Mist. Guaiaci ; Mist. Sp. Vini Gallici ; Pil. Ferri Iodidi ; Pulv. Amygd. Co. ; Pulv. Cretæ Aromat. ; Pulv. Glycyrrhizæ Co. ; Pulv. Trag. Co. ; Sodii Citro-tartras Eff. ; all the Syrups and Lozenges.

NAMES.	PARTS USED.	BOTANICAL NAMES.
Sambuci Flores ...	Fresh flowers ...	<i>Sambucus nigra</i> ...
Santali (oleum) ...	Volatile oil distilled from the wood	<i>Santalum Album</i> ...
Santonica ...	Dried unexpanded flower-heads	<i>Artemisia Maritima</i> ...
Sarsæ Radix ...	Dried root...	<i>Smilax officinalis</i> ...
Sassafras Radix ...	Dried root...	<i>Sassafras officinale</i> ...
Scammoniæ Radix	Dried root...	<i>Convolvulus Scammonia</i> ...
Scammoniæ Resina	Resin from the root	<i>Convolvulus Scammonia</i> ...
Scammonium ...	Gum-resin obtained from the living root	<i>Convolvulus Scammonia</i> ...
Scilla ...	Dried and sliced bulb	<i>Urginea Scilla</i> ...
Scoparii Cacumina	Fresh and dried tops	<i>Cytisus scoparius</i> ...
Senegæ Radix ...	Dried root...	<i>Polygala Senega</i> ...
Senna Alexandrina	Dried leaflets	<i>Cassia acutifolia</i> ...
Senna Indica ...	Dried leaflets	<i>Cassia angustifolia</i> ...
Serpentariæ Rhizoma	Dried rhizome and rootlets	<i>Aristolochia Serpentaria</i> or <i>Aristolochia reticulata</i>
Sinapis albæ Semina	Seeds	<i>Brassica alba</i> ...
Sinapis nigra Semina	Seeds	<i>Brassica nigra</i> ...
Staphisagriæ Semina	Dried ripe seeds	<i>Delphinium Staphisagria</i> ...
Stramonii Semina	Dried ripe seeds	<i>Datura Stramonium</i> ...
Styrax Præparatus	Balsam from the inner bark, purified	<i>Liquidambar orientalis</i> ...
Sumbul Radix ...	Dried sections of the root	<i>Ferula Sumbul</i> ...
Tamarindus ...	Preserved pulp of the fruit	<i>Tamarindus indica</i> ...
Taraxaci Radix ...	Fresh and dried root	<i>Taraxacum officinale</i> ...
Terebinthina Canadensis	Turpentine, known as Canada Balsam	<i>Pinus balsamea</i> ...
Theobromatis Oleum	Concrete oil	<i>Theobroma Cacao</i> ...

NATURAL ORDERS.	HABITATS.	OFFICIAL PREPARATIONS.
Caprifoliaceæ ...	Great Britain ...	Aqua Sambuci.
Santalaceæ ...	E. Indies, Tropical Asia and Australia	— —
Compositæ ...	Russia ...	Santoninum.
Smilaceæ ...	Jamaica ...	Dec. Sarsæ ; Dec. Sarsæ Co. ; Ext. Sarsæ Liq.
Lauraceæ ...	N. America ...	Dec. Sarsæ Co.
Convolvulaceæ ...	Syria & Asia Minor	Resina Scammoniaæ.
Convolvulaceæ ...	Syria & Asia Minor	Conf. Scammonii ; Ext. Colocynth. Co. ; Pil. Colocynthidis Co. ; Pil. Scam- monii Co. ; Pulv. Scammonii Co.
Convolvulaceæ ...	Syria & Asia Minor	Mist. Scammonii ; Resina Scammoniaæ.
Liliaceæ ...	Mediterranean ...	Acetum Scillæ ; Ox. Scillæ ; Pil. Ipe- cac. cum Scilla ; Pil. Scillæ Co. ; Syr. Scillæ ; Tinct. Scillæ.
Leguminosæ ...	Great Britain ...	Dec. Scoparii ; Succus Scoparii.
Polygalaceæ ...	N. America ...	Inf. Senegæ ; Tinct. Senegæ.
Leguminosæ ...	Egypt and Nubia...	Conf. Sennæ ; Inf. Sennæ ; Mist. Sennæ Co. ; Pulv. Glycyrrhizæ Co. ; Syr. Sennæ ; Tinct. Sennæ.
Leguminosæ ...	Southern India ...	Same as S. Alexandrina.
Aristolochiaceæ ...	N. America ...	Inf. Serpentariæ ; Tinct. Cinchonæ Co. ; Tinct. Serpentariæ.
Cruciferae...	Great Britain ...	Cataplasma Sinapis ; Charta Sinapis ; Oleum Sinapis.
Cruciferae ...	Great Britain ...	Cataplasma Sinapis ; Charta Sinapis ; Oleum Sinapis.
Ranunculaceæ ...	S. Europe ...	Unguentum Staphisagriaæ.
Solanaceæ ...	Great Britain ...	Ext. Stramonii ; Tinct. Stramonii.
Liquidambaraceæ	Asia Minor ..	Tinct. Benzoini Co.
Umbelliferae ...	Russia and India...	Tinct. Sumbul.
Leguminosæ ...	West Indies ...	Confectio Sennæ.
Compositæ ...	Great Britain ...	Dec. Taraxaci (dried root) ; Ext. Tarax- aci (fresh root) ; Ext. Taraxici Liquidum (dried root) ; Succus Taraxaci (fresh root).
Coniferae ...	Canada ...	Charta Epispastica ; Collodium flexile.
Sterculiaceæ ...	S. America and Mexico	The suppositories.

NAMES.	PARTS USED.	BOTANICAL NAMES.
Theriaca	Uncrystallizable residue left in refining of sugar	Saccharum officinarum ..
Thus Americana- num	Concrete turpentine ...	Pinus Tæda, P. Australis ..
Thymol	Stearoptene obtained from the volatile oils	Thymus vulgaris, } Monarda punctata, and } Carum Ajowan
Tragacantha ...	Gummy exudation from the stem	Astragalus gummifer
Uvæ Ursi Folia ...	Dried leaves	Arctostaphylos Uva Ursi .
Uvæ	Ripe fruit	Vitis vinifera
Valerianæ Rhi- zoma	Dried rhizome and rootlets	Valeriana officinalis
Veratri Viridis Rhizoma	Dried rhizome and rootlets	Veratrum viride
Zingiber	Scraped and dried rhizome	Zingiber officinale

NATURAL ORDERS.	HABITATS.	OFFICIAL PREPARATIONS.
Graminaceæ ...	S. America, India & Mexico	Tinct. Chloroformi et Morph., and numerous Pill masses.
Coniferæ ...	N. America ...	Emplastrum Picis.
Labiataæ ...	S. Europe and U. States	— —
Umbelliferæ ...	India, Persia and Egypt	— —
Leguminosæ ...	Asia Minor ...	Conf. Opii ; Conf. Sulphuris ; Gly. Tragacanthæ ; Mucilago Tragacanthæ ; Pulv. Opii Co. ; Pulv. Tragacanthæ Co.
Ericaceæ ...	N. Europe ...	Inf. Uvæ Ursi.
Vitaceæ ...	Spain ...	Tinct. Card. Co. ; Tinct. Sennæ.
Valerianaceæ ...	Great Britain ...	Inf. Valer. ; Tinct. Valer. ; Tinct. Valerianæ Ammoniata.
Melanthaceæ ...	U. States & Canada	Tinct. Veratri Viridis.
Zingiberaceæ ...	West Indies & India	Syr. Zingib. ; Tinct. Zingib. ; Tinct. Zingiberis fortior ; Conf. Opii ; Conf. Scammonii ; Inf. Sennæ ; Pil. Scillæ Co. ; Pulv. Cinnamoni Co. ; Pulv. Jalapæ Co. ; Pulv. Opii Co. ; Pulv. Rhei Co. ; Pulv. Scammonii Co. ; Vin. Aloes.

TABLE OF NATURAL ORDERS UNDER THE VARIOUS SUB-CLASSES, &c.

DICOTYLEDONES.					MONOCOTYLEDONES.	
Thalamifloræ.	Calycifloræ.	Corollifloræ.	Monochlamydeæ.	Gymnospermia.	Petaloidæ.	Glumaceæ.
Aurantiacææ.	Anacardiaceæ.	Asclepiadaceæ.	Aristolochiaceæ.	Conifereæ.	Araceæ.	Graminaceæ.
Berberidaceæ.	Amyridaceæ.	Boraginaceæ.	Artocarpaceæ.		ridaceæ.	
Byttneriaceæ.	Araliaceæ.	Compositæ.	Cupulifereæ.		Liliaceæ.	
Cruciferæ.	Cucurbitaceæ.	Caprifoliaceæ.	Cannabineæ.		Melanthaceæ.	
Camelliaceæ.	Leguminosæ.	Convulvulaceæ.	Hamamelideæ.		Smilaceæ.	
Canellaceæ.	Myrtaceæ.	Ericaceæ.	Euphorbiaceæ.		Zingiberaceæ.	
Erythroxylaceæ.	Rhamnaceæ.	Gentianaceæ.	Lauraceæ.			
Guttiferæ.	Rosaceæ.	Labiataæ.	Moraceæ.			
Linaceæ.	Umbellifereæ.	Lobeliaceæ.	Myristicaceæ.			
Magnoliaceæ.		Loganiaceæ.	Polygonaceæ.			
Malvaceæ.		Oleaceæ.	Piperaceæ.			
Menispermaceæ.		Rubiaceæ.	Salicaceæ.		Acrogenæ.	Thallogeneæ.
Papaveraceæ.		Sapotaceæ.	Santalaceæ.		Filices.	Algæ.
Polygalaceæ.		Styraceæ.	Thymelaceæ.			Fungi.
Rutaceæ.		Solanaceæ.	Ulmaceæ.			Lichenes.
Ranunculaceæ.		Scrophulariaceæ.				
Sapindaceæ.		Valerianaceæ.				
Simarubaceæ.						
Vitaceæ.						
Zygophyllaceæ.						
					ACOTYLEDONES.	

ADVANCED
MATERIA MEDICA.

DE CANDOLLE'S

In this system plants are classified according to their essential organs,

THE VEGETABLE KINGDOM

1. Phanerogamia.

Flowering or Cotyledonous Plants, propagated by seeds, having a visible embryo, divided into 2 sub-classes.

1. Endogens or Monocotyledones.

Seeds containing one cotyledon, germination endorhizal, parallel veined leaves, parts of the flower arranged in "threes."

These are divided into :—

1. Glumaceæ.

Leaves usually permanent, no petals or sepals, flowers enclosed in bracts called glumes and paleæ.

2. Petaloideæ.

Leaves usually permanent, perianth verticillate, sometimes absent.

This sub-class has 3 subdivisions :—

1. EPIGYNÆ.—Flowers hermaphrodite, perianth adherent, ovary inferior.
2. HYPOGYNÆ.—Flowers hermaphrodite, perianth free, ovary superior.
3. DICLINES.—Flowers unisexual, perianth either absent or consisting of scales.

3. Dictyogenæ.

Leaves reticulated, deciduous, floral envelope verticillate, wood arranged in the roots in a concentric manner.

2. Exogens or Dicotyledones.

Seeds containing two cotyledons, germination exorhizal, reticulated leaves, parts of the flower arranged in "fours" or "fives."

These are divided into :—

1. Gymnospermia.

Ovules naked or not enclosed in an ovary ; they are fertilized directly by the action of the pollen on the ovules.

Example.—Coniferæ.

2. Angiospermia.

Ovules enclosed in an ovary, and fertilized indirectly by the action of the pollen on the stigma.

This is divided into 4 sub-classes :—

1. Thalamifloræ.

2. Calycifloræ.

3. Corollifloræ.

4. Monochlamydeæ.

(For the description of these, see next page.)

NATURAL SYSTEM.

growth of the stems, and the number of their cotyledons or seed-leaves.

divided into 2 sub-kingdoms.

2. Cryptogamia.

Flowerless or Acotyledonous Plants, propagated by spores instead of seeds, germination heterorhizal, leaves when present, with furcate venation; divided into 2 sub-classes.

1. Thallogenæ.

No distinction between stems and leaves, and no stomata.

2. Acrogenæ.

A distinguishable stem, and stomata.

1. Thalamifloræ.

Calyx and corolla, petals distinct, inserted on thalamus, stamens hypogynous, or adherent to the sides of the ovary.

2. Calycifloræ.

Calyx and corolla, petals usually distinct, inserted on the calyx, stamens perigynous or epigynous.

This is divided into 2 sub-divisions.

1. Perigynæ.

Calyx free, stamens perigynous, ovary superior.

2. Epigynæ.

Calyx adherent, stamens epigynous, ovary inferior.

3. Corollifloræ.

Usually both sepals and petals, petals united, stamens inserted on the corolla or ovary, or free and arising from the thalamus.

This sub-class is divided into 3 sub-divisions:—

1. EPIGYNÆ.—Calyx adherent, ovary inferior.

2. HYPOSTAMINEÆ.—Stamens hypogynous, ovary superior.

3. EPIPETALÆ.—Corolla hypogynous, stamens epipetalous, ovary superior.

4. Monochlamydeæ.

No petals, sepals only, these sometimes absent.

SUB-KINGDOM—Phanerogamia.

CLASS.—Dicotyledones.

SUB-CLASS.—Thamalifloræ.

RANUNCULACEÆ.

No. 1. Aconiti Folia. *Aconite Leaves.*

The fresh leaves and flowering tops of *Aconitum Napellus*, *Monkshood*, gathered when about one-third of the flowers are expanded, from plants cultivated in Britain.

Habitat.—Britain, where the plant is cultivated; it is also found throughout the greater portions of Europe and Asia.

Characters.—The leaves are alternate, with long grooved petioles, very deeply palmately divided into three or five segments, which are again irregularly and deeply divided into oblong acute narrow lobes. The leaves are smooth, with a leathery texture, colour bright green on the upper surface and shining, somewhat paler on the under surface. In the dry state the leaves have a peculiar herbaceous odour and a bitter acrid taste, followed by a sensation of tingling and numbness. The flowers, arranged in loose terminal racemes, are zygomorphic; calyx, galeate, enclosing two long hammer-shaped petals; colour deep blue; stamens numerous and hypogynous; fruit consisting of three follicles.

The reason for collecting the leaves when the plant is commencing to flower, is that during the first growth of the plant numerous organic products are formed, many of them being afterwards utilized in the after-growth, such products would necessarily add to the weight of the plant; but during their assimilation other products are produced which play no active part in the life of the plant, and amongst these is the alkaloid to which the medicinal properties of the drug are due, consequently by the removal of nutritive products a concentration of the active constituent is obtained.

Ranunculaceæ.

The leaves are reported to be about one-sixth the strength of the root.

Composition.—The leaves contain aconitine in small quantities combined with aconitic acid, gum, albumen, and chlorophyll. Aconitic Acid, $H_3 C_6 H_3 O_6$, is also found in *Equisetum fluvatile* and other plants. It is best prepared by heating citric acid in retorts until oily globules appear to condense in the retort, then removing the heat, and when cold, exhausting with ether. Aconitic acid is readily obtained by heating equal parts of citric and sulphuric acids with one part of water in a reflux apparatus, and when cold agitating with ether. During the reaction, acetone, carbonic anhydride, and carbon monoxide are formed.

Official Preparation.—*Extractum Aconiti.*

No. 2. Aconiti Radix. Aconite Root.

The root of *Aconitum Napellus*, collected in winter or early spring before the leaves have appeared, from plants cultivated in Britain, and carefully dried; or imported in a dried state from Germany.

Habitat.—Britain and the Continent of Europe.

Characters.—Usually from about two to three inches long, and about three quarters of an inch thick at the upper extremity, which is usually surmounted by the remains of the stem, or terminal bud, conical in form; the numerous rootlets are generally detached, leaving scar-like markings. It is of a dark chocolate brown colour externally, much shrivelled longitudinally and breaking with a non-fibrous fracture, internally whitish and the central cylinder arranged in a radiating manner if the root is young, but in an old root the colour is brownish and the central axis hollow. Each radiating portion of the centre contains a vascular bundle. Odour pungent when fresh, but little or no odour when dried; taste at first slightly bitter, afterwards producing tingling and numbness.

The roots are frequently regarded as tubers, from their peculiar growth, the first root producing a lateral bud which develops into a short rhizomatous structure, develop-

Ranunculacea.

ing again into another root, so that frequently two or even three roots will be found attached to one another.

Aconite root has sometimes been mistaken for horseradish root, chiefly due to the fact that the fresh root possesses a pungent odour not unlike horseradish. This mistake has more than once resulted in cases of fatal poisoning. They may be distinguished by the following characters :—

Aconite Root

Is from two to three inches long, conical and rapidly tapering to a fine point, chocolate coloured, odour pungent only when fresh, and when scraped slowly turning pink, and producing when chewed a sensation of tingling and numbness.

Horseradish Root

Is from six to twenty inches in length, cylindrical, terminating abruptly of a uniform thickness for several inches in length, colour light yellow or brownish white, possessing a characteristic extremely pungent odour on scraping, and not altering in colour on standing for some time.

Composition.—Aconite root contains about .03 per cent. of the alkaloid aconitine, in combination with aconitic acid, also napelline, aconine, and picraconitine, besides resin, mannite, fat, and sugars.

Aconitine ($C_{33}H_{43}NO_{12}$).—The commercial varieties of this alkaloid differ much from one another in physiological action and appearance, a fact which is partly explained by the numerous methods employed for its extraction, and also that there are over twenty varieties of *Aconitum Napellus*, and other species of *Aconitum*, and that these do not yield identical alkaloids. Most of the processes employed, including that of the British Pharmacopœia, yield a more or less amorphous gummy alkaloid; the following method by Williams yields almost pure crystallised aconitine. The root is coarsely powdered and exhausted with 64 over proof spirit or methylated spirit free from resinous or gummy matter, acidulated with tartaric acid, first macerating and then repeatedly percolating; from the percolate the spirit is distilled off at the

Ranunculaceæ.

lowest possible temperature, adding a little hot water towards the end and then gently heating on a water bath. The thin aqueous extract is now filtered through paper previously moistened with water, which separates resin, the filtrate is then agitated with a little ether to remove oily matter, and any trace of ether removed by gently warming. To this liquid is now added a slight excess of a concentrated solution of normal sodium carbonate and gently warmed, the agglomerated resinous mass is collected and washed with hot water until the washings are colourless. The mass is powdered and dried in a hot-air closet, it is now repeatedly macerated in pure anhydrous ether, the liquids mixed and allowed to spontaneously evaporate in a shallow basin. Any traces of gummy noncrystalline matter may be removed by washing the crystals with a little cold pure ether. It may further be converted into nitrate by dissolving in dilute nitric acid and then adding stronger acid and again precipitating with normal sodium carbonate, removing with pure ether. Aconitine crystallises in flat prisms with pointed ends, but the commercial alkaloid is usually an amorphous solid, very sparingly soluble in water, much more so in alcohol or ether; it is freely soluble in dilute mineral acids, forming crystallisable salts, also in benzol and chloroform. When pure the alkaloid is said to give no characteristic reactions with acids or oxidising agents. On heating the alkaloid to 100°C with a strong solution of tartaric acid it yields apoaconitine; when with an alcoholic solution of potassic hydrate it decomposes into benzoic acid and amorphous aconine. $\text{C}_{33}\text{H}_{43}\text{NO}_{12} + \text{H}_2\text{O} = \text{C}_7\text{H}_6\text{O}_2 + \text{C}_{26}\text{H}_{39}\text{NO}_{11}$, this reaction is the basis of one of the methods of assaying commercial aconitine. since aconitine yields nearly one-sixth its weight of benzoic acid, which can be extracted and weighed.

Aconine, $\text{C}_{26}\text{H}_{39}\text{NO}_{11}$, is an amorphous substance readily soluble in water but insoluble in ether, and is identical with napelline.

Picraconitine, $\text{C}_{31}\text{H}_{45}\text{NO}_{10}$, is an alkaloid only found in some varieties of the root; when boiled with an alcoholic potash solution it decomposes into benzoic acid and picraconine.

Ranunculaceæ.

Adulterations.—Aconite root is not infrequently admixed with the roots of other species of Aconite, *e.g.*, A. Cammarum, A. Stoerckanum, and also the roots of Imperatoria Ostruthium have been found. They are readily identified by their aromatic odour and pungent taste.

Therapeutics.—Sedative, anodyne, and in large doses a virulent poison.

Official Preparations.—Aconitina; Tinctura Aconiti; Lin. Aconiti; Unguent. Aconitinæ.

*Allied Species.***2a. Aconitum Ferox.** *Nepal Aconite or Bish.*

This plant is indigenous to the Himalayas; the root is dug up and dried, and is occasionally met with in commerce.

Characters.—The dried root varies from two to five inches long, and is about one inch in diameter at its base, tapering to a point; frequently the apex is absent; externally it is wrinkled longitudinally, and of a dark brown colour which becomes much lighter on rubbing; internally, if the root is young, it is whitish in colour, and spongy; old roots are resinous, and vary from a light yellow to dark brownish-yellow, and are slightly translucent in appearance, odourless, and similar in taste to aconite root, and closely resemble the tubers of Tampico Jalap.

Composition.—This root yields pseudoaconitine, its chief alkaloid, which it contains in two forms, amorphous and crystalline, both of which yield uncrystallisable salts with acids. Pseudoaconitine, $C_{36}H_{49}NO_{12}$, was formerly said to be identical with aconitine; when pseudoaconitine is saponified with



ACONITUM FEROX.

Ranunculaceæ.

alcoholic potash it yields pseudoaconine and dimethyl protocatechuic (veratric) acid, $C_{36}H_{49}NO_{12} + H_{20} = C_{27}H_{40}NO_9 + C_9H_{10}O_4$. Pseudoaconitine may be identified from aconitine by its being much less soluble in chloroform and ether, and by yielding 26.5 per cent. of veratric acid on saponification.

2b. Aconitum Fischeri. *Japanese Aconite Root.*

This plant is indigenous to China and Japan, and is grown largely in the United States, where it constitutes the only American source of aconitine. (Lloyd.)

Characters.—The dried root is from three-quarters to one and a half inch long, conical and tapering to a fine point; externally of a dull ashy-grey colour, smooth, with numerous short thickened rootlets; internally it is white, and breaks with a starchy fracture; odourless, and similar in taste to the others.

Composition.—This root yields an alkaloid called japaconitine, which appears to be closely allied to, if not identical with, aconitine. Japaconitine, $C_{66}H_{88}N_2O_{21}$, when saponified with alcoholic potash, yields benzoic acid and japaconine.

The physiological action of the root has been shown by Bartholin to differ from that of *A. Napellus*, consequently it cannot be used to replace the official drug.



ACONITUM FISCHERI.

Aconitum Heterophyllum. *Atis or Atees Root.*

Indigenous to the Himalayas.

Characters.—The roots are fusiform or obconical, from half to one and a half inches long, externally yellowish-gray, with numerous scars of rootlets, and wrinkled;

Ranunculaceæ.

internally white and starchy; odourless; taste bitter but nonacrid.

Composition.—This root contains no aconitine and is non-poisonous, but it contains an alkaloid, atisine, $C_{46}H_{74}N_2O_5$.

No. 3. Podophylli Rhizoma. *Podophyllum Rhizome.*

The dried rhizome of *Podophyllum peltatum* or the American *May Apple*. It is this rhizome which is called mandrake in the United States.

This plant is placed by some botanists under the *Berberidaceæ*.

Habitat.—United States of North America.

Characters.—*Podophyllum* root, as it is sometimes called, is known to be a rhizome by its producing buds and leaves on its upper surface, and rootlets from its lower surface. Along the rhizome, at intervals, more or less flattened and swollen portions are found (*a*), presenting on their upper surfaces a number of rings, produced by the falling off of the leaves, and on their lower surfaces white scars (*b*), due to the detachment of the brittle rootlets. Sometimes the rootlets themselves are found on the rhizome.

Composition.—The rhizome contains from $3\frac{1}{2}$ to 5 per cent. of resin, which is the active ingredient, it is partly soluble in ether, the soluble portion alone being purgative. These resins form the Podophyllin of commerce. The variation in colour of the commercial article has been shown to be largely due to the more or less fine state of division in which it is precipitated. The resin has been analysed by Podwyssotzki, who obtained from it podophyllotoxine, podophyllic acid and Podophylloquercetin. Podophyllo-toxine yields on decomposition picra-podophyllin and picro-podophyllic acid. The greenish tint sometimes present in the resin is said to be due to Podophylloquercetin, the griping principle of the resin. The inert portion of the resin, insoluble in ether, contains the podophyllic acid.

Therapeutics.—The Resin or Podophyllin acts as a drastic purgative. Dose, from $\frac{1}{4}$ gr. to 2 gr.

Official Preparation.—Podophylli Resina.



N^o 1.



N^o 2.



N^o 3.



N^o 8.



N^o 10.

*Ranunculaceæ.***No. 4. Hydrastis.** *Hydrastis.*

(~~Not~~ official.)

Yellow Root. Golden Seal. Indian Turmeric.

The dried rhizome and rootlets of *Hydrastis Canadensis*.

Habitat.—Indigenous to Canada and some districts of the United States.

Characters.—The rhizome is from one to two inches long, and about a quarter of an inch thick, irregular and knotty, wrinkled longitudinally, and on the under surface numerous rootlets are attached; the rhizome is brownish-grey externally, and when broken shows a waxy fracture of a brownish-yellow colour; the central axis is divided into numerous wedges; odour, earthy; taste, bitter.

Composition.—The rhizome contains berberine and hydrastin, fatty oil, sugar, and gum.

Hydrastin, $C_{21}H_{21}NO_6$. This alkaloid is prepared by exhausting the rhizome with ether, distilling off the ether, and dissolving the residue in boiling alcohol. On cooling the alcoholic filtrate deposits crystals of pure hydrastin. Hydrastin crystals melt at $132^{\circ} C.$, and when oxidised with potassium permanganate, yield hydrastinine and opianic acid; it dissolves in acids, forming crystallisable salts.

Berberine, $C_{20}H_{17}NO_4$. This alkaloid is retained in the alcoholic filtrate after the hydrastin crystallises out, and is obtained by evaporating to dryness, redissolving in dilute sulphuric acid, filtering, then adding lead oxide and warming; after standing, the clear solution is decanted and concentrated, when the berberine crystallises in fine needles.

An alcoholic solution precipitates dark green scales on the addition of iodine solution in potassium iodide; berberine hydrochloride gives a blood red colour with chlorine.

Therapeutics.—Used as a tonic for the mucous membrane.

No. 5. Hellebori Nigri Rhizoma. *Black Hellebore Rhizome.*

The dried rhizome and rootlets of *Helleborus Niger* or Christmas Rose.

Ranunculaceæ.

Habitat.—Indigenous to Southern Germany, France, and Italy.

Characters.—The rhizome and rootlets present an irregular appearance, about two or three inches long, marked on the upper surface with numerous scars, and from the under surface proceed short black rootlets, which are generally absent in the commercial drug; internally it is whitish, and the central axis is usually divided into wedge-shaped segments; scarcely any odour; taste sweet, then bitter and acrid.

Composition.—The rhizome contains two glucosides, helleborin and helleborein, resin, gum, and starch.

Helleborin is obtained by concentrating the tincture and dissolving the residue in hot water, filtering from resin and allowing to stand, when it crystallises out.

Helleborin is obtained from the clear liquid by adding lead acetate and sodium sulphate, filtering and adding tannin; the precipitate is triturated with lead oxide and exhausted with alcohol and filtered; on the addition of ether helleborein crystallises out.

Helleborin yields, on hydrolysis with zinc chloride, an amorphous substance, helleboresin.

Helleborein by the same treatment yields helleboretin and dextrose.

Adulterations.—Sometimes the rhizomes are contaminated with those of *Actæa Spicata*, the rootlets of which have the central axis divided into four. The rhizome of *Adonis Vernalis* has also been found.

Allied Species.

The rhizomes of *H. Viridis*, *H. Fœtidus*, *H. Orientalis*, are closely allied to those of *H. Niger*, and probably contain the same constituents.

No. 6. Staphisagriæ Semina. Stavesacre Seeds.

The dried ripe seeds of *Delphinium Staphisagria*.

Habitat.—Indigenous to the countries bordering on the Mediterranean, and imported from Trieste.

Ranunculaceæ.

Characters.—The seeds are irregularly triangular or quadrangular, acutely angled and one side convex. The testa is dark brown in colour, deeply pitted, wrinkled, and brittle; nucleus whitish, soft and oily; odour faintly narcotic; taste nauseous, bitter, and acrid.

Composition.—The seeds contain the alkaloids delphinine, delphinoidine, and staphisagrine, also from 25 to 30 per cent. of a fatty oil.

Delphinine, $C_{22}H_{35}NO_6$, crystallises in flat prisms, almost insoluble in water, readily in ether, less so in chloroform and alcohol. When applied to the tongue it produces tingling similar to aconitine; with strong sulphuric acid and sugar it gives a green colour.

Delphinoidine is amorphous, very readily soluble in alcohol; it gives with Fröhde's reagent a blood-red colour.

Staphisagrine is almost insoluble in ether, sparingly in water, and readily in chloroform or alcohol; it gives with sulphuric acid a cherry red.

These alkaloids are found principally in the testa of the seed.

The fatty oil is prepared by expression, it is a non-drying oil, and is used largely as a lubricant.

Therapeutics.—Used externally for destroying pediculi.

Official Preparation.—Unguentum Staphisagriæ.

No. 7. Cimicifuga Rhizoma. Cimicifuga.*Actæa Root.*

The dried rhizome and rootlets of *Cimicifuga racemosa*.

Habitat.—Indigenous to Canada and the United States.

This plant is distinguished from *Actæa Spicata* by its capsular fruit, whereas the latter has a succulent red fruit.

Characters.—The rhizome is from two to six inches long, and about half-an-inch thick, somewhat flattened, with numerous short stout branches, and on the under surface a number of wiry slender rootlets which are generally broken off. Both rhizome and rootlets are brownish-black, odourless, and have a bitter and slightly acrid taste. Their

Magnoliaceæ.

fracture is nearly smooth and slightly fibrous. The central axis is arranged into a series of woody wedges producing a stellate appearance.

Composition.—Cimicifuga contains a resin called cimicifugin or macrotin, tannin, and a neutral crystalline principle.

Cimicifugin is prepared by exhausting the rhizome with alcohol, concentrating the tincture, and then pouring into water, when it is precipitated. The yield amounts to from 3 to 4 per cent.

Therapeutics.—Nervine tonic and sedative.

Official Preparations.—Extractum Cimicifugæ Liquidum; Tinctura Cimicifugæ.

MAGNOLIACEÆ.**No. 8. Anisi Stellati Fructus. *Star-Anise Fruit.***

The dried fruit of *Illicium anisatum*. From plants cultivated in China.

Habitat.—It is indigenous to the mountains of Yunnan, in South Western China.

Characters.—Star Anise fruit is generally composed of eight fully developed carpels, the boat-shaped follicles are arranged horizontally on a short axis. The follicles are about three quarters of an inch long, more or less beaked, the beak being frequently broken off, irregularly wrinkled, woody, of a rusty brown colour, and usually split in the upper margin, exposing slightly a solitary flat seed; internally smooth, glossy and reddish-brown. The seed is oblique, oval, of a brownish-yellow colour. Odour and taste resembling anise fruit.

Composition.—The fruit contains a volatile oil, resin and fat, the seed containing a small quantity of volatile oil, and about 20 per cent. of fatty oil, and a little resin.

The Volatile Oil is principally distilled in China from the fruit with water, the yield amounting to from $2\frac{1}{2}$ to 5 per cent. The volatile oil is a pale yellow, becoming darker on

Magnoliaceæ.

keeping, and has an aromatic odour; at low temperatures the oil solidifies into a crystalline mass. The true anise oil congeals between 10° and 15° C, while that of Star anise congeals at 2° C; it is freely soluble in alcohol and ether. The oil contains a small quantity of a hydrocarbon, $C_{10}H_{16}$, but it principally consists of Anisol, $C_{10}H_{12}O$; with oxidising agents it is converted into anisic acid.

Adulterations.—The Volatile Oil, as met with in commerce, is sometimes mixed with alcohol, spermaceti, camphor, or wax. When adulterated with alcohol it turns milky-white on the addition of water. Camphor may be detected by pressing the crystalline cake, or by dissolving in alcohol and pouring into warm water, when it separates as a flocculent precipitate. The other two are detected by their insolubility in alcohol.

Therapeutics.—Used as an aromatic and carminative.

Official Preparations.—Oleum Anisi; Essentia Anisi.

Allied Plant. *Illicium Religiosum.* *Japanese Star Anisi.*
Shikimi Fruit.

These fruits were first supposed to be identical with the preceding.

Habitat.—Indigenous to Eastern Asia; cultivated in Japan.

Characters.—The fruits resemble, in many respects, those of Star Anise, but as a rule only a few of them arrive at maturity. The apex terminates with a short curved beak; they possess a slight clove-like odour.

Composition.—The fruits yield a volatile oil, Shikimic acid and Shikimipicrin. The oil is of a similar composition to that of Star Anise. Shikimic acid occurs in crystals readily soluble in water, insoluble in alcohol. Shikimipicrin is crystalline and readily soluble in warm alcohol.

The fruits of this plant are poisonous.

No. 9. Winteri Cortex. *Winter's Bark.*

(Not official.)

The bark of *Drimys Winteri*, or *Drimys aromatica*.

Menispermaceæ.

Habitat.—Straits of Magellan, and the Western parts of South America to Mexico.

Characters.—Winter's Bark occurs in broken curved pieces or in quills; externally gray or whitish, marked with brown spots; internally blackish-brown, coarsely striated, fracture short, odour agreeable; taste aromatic and pungent.

Composition.—The bark contains about 10 per cent. of tannin, 1.2 per cent. of volatile oil, and starch.

Adulteration.—True Winter's Bark is seldom met with in commerce, frequently Canella Bark is substituted for it, but this is much paler and contains no tannin. The bark of *Cinnamodendron Corticosum* is principally supplied for it.

Therapeutics.—Used as an aromatic and tonic.

MENISPERMACEÆ.**No. 10. Calumbæ Radix. Calumba Root.**

The dried transversely cut slices of the root of *Jateorhiza Calumba*.

Habitat.—Indigenous in Mozambique, and to the Southern parts of Eastern Africa, and along the Zambesi River; cultivated in the East Indies.

Characters.—Columba root is in irregular flattish circular discs, from one to two inches in diameter, and varying in thickness. The central portion is thin and depressed; the cortical part covered with a wrinkled brownish-yellow coat, and separated from the centre by a dark line; colour greenish-yellow, odour musty, taste bitter, fracture starchy. It is frequently worm-eaten; principally imported from Zanzibar.

Composition.—Calumba root contains calumbin, berberine and calumbic acid, also about 33 per cent. of starch.

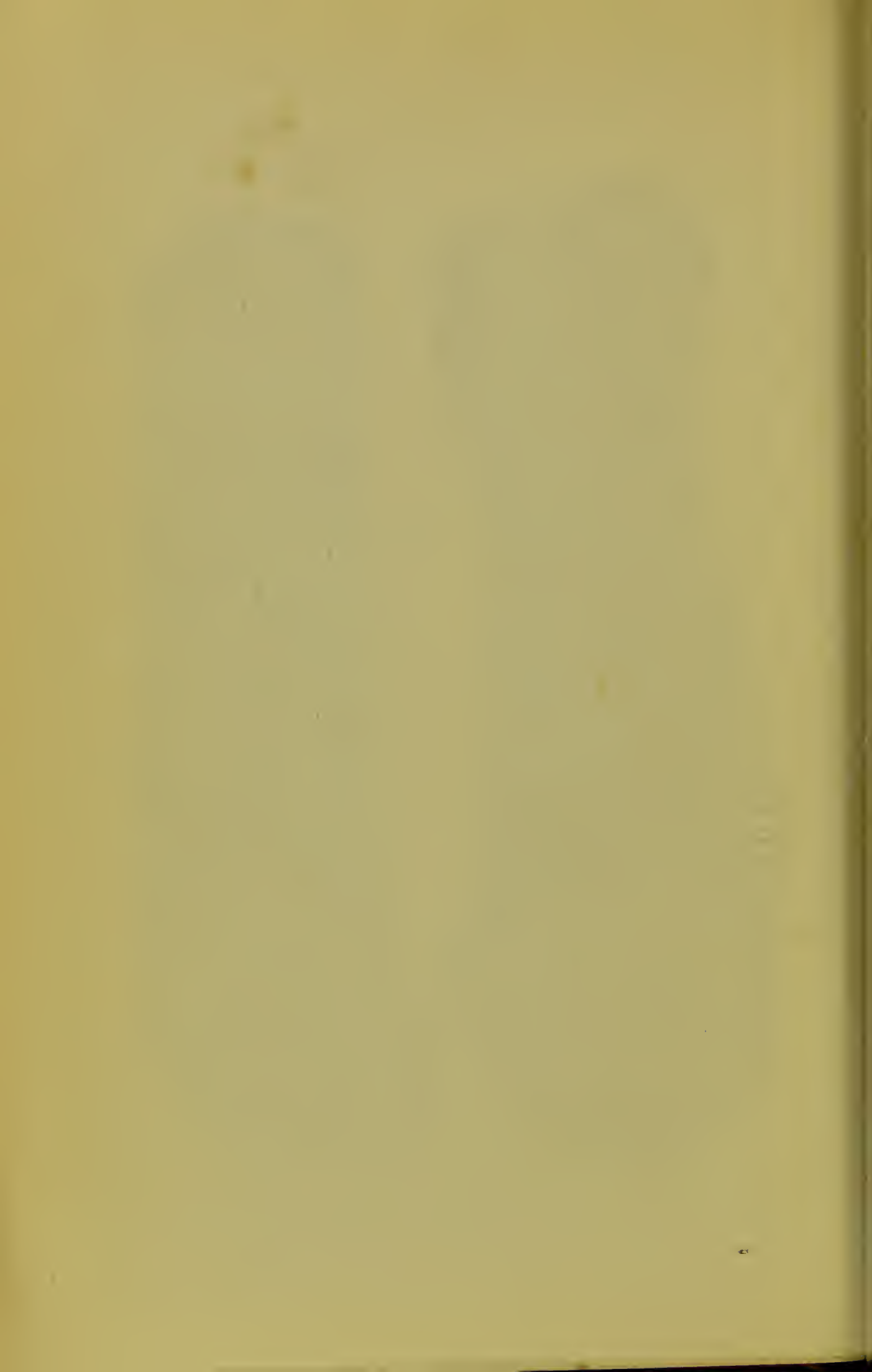
Calumbin, $C_{42}H_{44}O_{14}$, is prepared by dissolving the alcoholic extract in water, and agitating with ether, decanting the ether and allowing it to evaporate. It forms needles and



No 11.



No 11a



Menispermaceæ.

prisms; it has a bitter taste, is soluble in hot alcohol, but insoluble in water.

Calumbic acid, $C_{22}H_{24}O_7$, is a pale yellow bitter substance, almost insoluble in cold water.

Adulterations.—Bryony Root from *Bryonia dioica*, and the root of *Fraseri Walteri* have been sold for *Calumba*, also the stem of *Coscinium fenestratum*, but they have scarcely any resemblance to *Calumba*.

Official Preparations.—*Extractum Calumbæ*; *Infusum Calumbæ*; *Tinctura Calumbæ*; *Mistura Ferri Aromatica*.

No. 11. Pareiræ Radix. *Pareira Root.*

The dried root of *Chondrodendron tomentosum*. It is commonly called *Pareira Brava*.

Habitat.—Brazil.

Characters.—In long, nearly cylindrical, more or less twisted pieces, from about three-quarters of an inch to two or more inches thick; covered with a thin, blackish-brown bark, and marked externally with longitudinal furrows and transverse ridges and fissures. Internally yellowish or brownish-grey, with well-marked concentric or more or less eccentric circles of porous wood, separated into wedge-shaped portions by large medullary rays, and when cut presents a waxy appearance. It has no odour, but a bitter taste. Its decoction, when cold, is turned inky bluish-black by solution of iodine.

Composition.—Fluckiger has shown in his analysis of this drug that it contains the alkaloid Pelosine or Ciss-compeline, chemically identical with Beberine and Buxine.

Adulterations.—Previous to the discovery of the true source of *pareira* root, the roots of some allied species were almost entirely found in commerce; all that is known about them is, that they were derived from some menispermaceous plants of unknown origin; that they belong to the *Menispermaceæ* is evident from the peculiar structure of their wood. The true *pareira* root may be distinguished from the adulterations by the following characters:—

Menispermaceæ.

The true root is darker in colour externally ; it generally possesses only three or four concentric rings of wood, arranged in a very irregular manner, and has a smooth waxy cut.

The substituted root (see No. 11a), generally possesses a number of concentric rings arranged in a regular manner, and when cut presents a rough surface, due to the cells not being in such a compact condition as in the true root.

The stems of the *Chondrodendron tomentosum*, and of allied species, have been substituted for the official root.

The root may be distinguished from the stem as follows:—The root is darker and more irregular than the stem ; it generally has short rootlets, but it has no perceptible pith, nor any development of lichens.

The stem has a pith and an evident development of lichens.

Therapeutics.—Pareira root is a tonic and diuretic.

Official Preparations.—Decoctum Pareiræ ; Extractum Pareiræ ; Extractum Pareiræ Liquidum.

No. 12. Cocculus. *Cocculus Indicus*, or *Levant Nut*.

(~~Not~~ official.)

The dried fruit of *Anamirta Cocculus*, or *A. Paniculata*.

Habitat.—Indigenous to India.

Characters.—The fruit is a globular, kidney-shaped drupe, the pericarp is blackish-brown in colour externally, whitish within, and contains an oily reniform seed. Occasionally they have been mistaken for bay berries. They may be distinguished as follows :—

Cocculus Indicus.**Bay Berries.**

Reniform, and when shaken the seed does not rattle.

Oval and larger than cocculus ; the seed rattles when shaken.

Composition.—Cocculus fruit contains in the shell menispermene, paramenispermene, and hippopicrotoxic acid, and the oily seed contains picrotoxin.

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Menispermine, $C_{18}H_{24}N_2O_2$, and paramenispermine are both identical, but differ in that the latter is insoluble in ether and does not neutralise acids.

Picrotoxin, $C_{12}H_{14}O_5$, is obtained from the crushed seeds, freed from oil by ether, by exhausting with boiling alcohol, concentrating by distillation, filtering, acidulating with sulphuric acid and crystallising, afterwards recrystallising from alcohol. It is in colourless crystals, sparingly soluble in boiling water and alcohol; with bichromate of potassium and sulphuric acid it gives a violet red; boiled with neutral lead acetate it gives a black precipitate. It has lately been resolved into three distinct bodies.

Therapeutics.—It is employed to destroy pediculi.

PAPAVERACEÆ.**No. 13. Rhœados Petala. Red Poppy Petals.**

The fresh petals of *Papaver Rhœas*. From indigenous plants.

Habitat.—Indigenous in Europe.

Characters.—The petals are of a bright scarlet when fresh, frequently almost black at the base, usually rounded in outline and unequal in size, with a heavy narcotic odour; taste faintly bitter and mucilaginous. When dried they are purplish in colour and tasteless.

Composition.—Red poppy petals contain two colouring principles, rhœadic and papaveric acids, gum, wax, starch, and albumen. Rhœadic acid is an amorphous body, soluble in water and alcohol, insoluble in ether, and forming brown coloured salts with alkalies. Papaveric acid, which is bright red, is soluble in diluted alcohol and water, and with the alkalies forms violet-coloured compounds; both acids are precipitated from their aqueous solutions with basic lead acetate. The petals contain no morphine, but minute quantities of rhœadine (Hesse). An extract is frequently employed as a colouring agent in the manipulation of wines.

Official Preparation.—Syrupus Rhœados.

*Papaveraceæ.***No. 14. Papaveris Capsulæ. Poppy Capsules.**

The nearly ripe dried capsules of *Papaver somniferum*, the opium poppy.

Habitat.—Cultivated in Britain.

Characters.—There are three well marked varieties of the *Papaver somniferum*, viz :—

1	2	3
Papaver somniferum—var. glabrum.	Papaver somniferum—var. album.	Papaver somniferum—var. setigerum.
Petals usually, red. Capsule dehiscing by pores, situated under the stigma, seeds dark coloured. These seeds are commonly called <i>maw seeds</i> . Stigmas, 10 to 12.	Petals white. Capsule indehiscent, more or less egg-shaped. Seeds white.	Petals particoloured. Leaves, peduncles, and calyces covered with stiff hairs. Stigmas, 7 to 8.

Poppy capsules are most active before they are quite ripe, and should be gathered at that period. The top of each capsule is crowned by stellately-arranged stigmas. Within, the seeds are attached to parietal placentæ, which project into the cavity of the ovary, and which are equal in number to the stigmas.

The capsule contains a very large number of loose, small, reniform, whitish, slate-coloured, or nearly black seeds, known as *maw seeds*.

Composition.—Poppy Capsules contain a small amount of the principles found in opium. According to Merck, they have yielded 2 per cent. of Morphine; they also contain Papaverine and Papaverosine. Rhœadine has been found in nearly all parts of the plant. From the seeds a fixed oil, called poppy-oil, is obtained by expression.

Official Preparations.—Decoctum Papaveris; Extractum Papaveris; Syrupus Papaveris.



Nº 16.



Nº 17.



*Papaveraceæ.***No. 15. Opium. *Opium.***

The juice obtained by incision from the unripe capsules of *Papaver somniferum*, and hardened by spontaneous evaporation.

Habitat.—Asia Minor; cultivated also in Egypt, Persia, India, and China.

Collection.—Opium is obtained by making incisions into the poppy capsules a few days after the petals have fallen; the incisions are made either horizontally, spirally, or vertically, so as to cut the laticiferous vessels in which the juice is contained, and which permeate in every direction. In Asia Minor and Smyrna the incisions are made horizontally, and extend about three-fourths round the capsule. In India the incisions are made vertically. Care must be taken that the incision does not go through the pericarp, as this would cause most of the milky juice to flow into the inside and to be lost, and would also prevent the ripening of the seeds, which alone will pay the cost of the cultivation of the poppy, on account of the oil obtained from them. The exuded juice, which is at first of a white colour, soon becomes brown and concretes in the form of tears, which are then scraped off and either worked up into a mass, or the separate tears are simply put together. The opium is further dried in the shade, and the masses are usually enveloped with some leaf.

Characters.—Several varieties of opium are found in commerce, viz: Smyrna, Constantinople, Egyptian, Persian or Trebizond, Indian, and European. Of these the first four only are found in English commerce; the Smyrna and Constantinople opiums are the only official ones; the other opiums should not be employed in making the preparations of the Pharmacopœia.

No. 16. Smyrna Opium, commonly called Turkey or Levant opium, occurs in masses, made up of agglutinated tears, weighing from half to two pounds. These masses are wrapped up in poppy leaves, which possess a stout

Papaveraceæ.

mid-rib and pinnate venation, and are generally covered externally by the capsules of a species of *Rumex*; instead of the capsules their triangular fruits are frequently found on the masses of opium, on account of their calyces having been rubbed or shaken off.

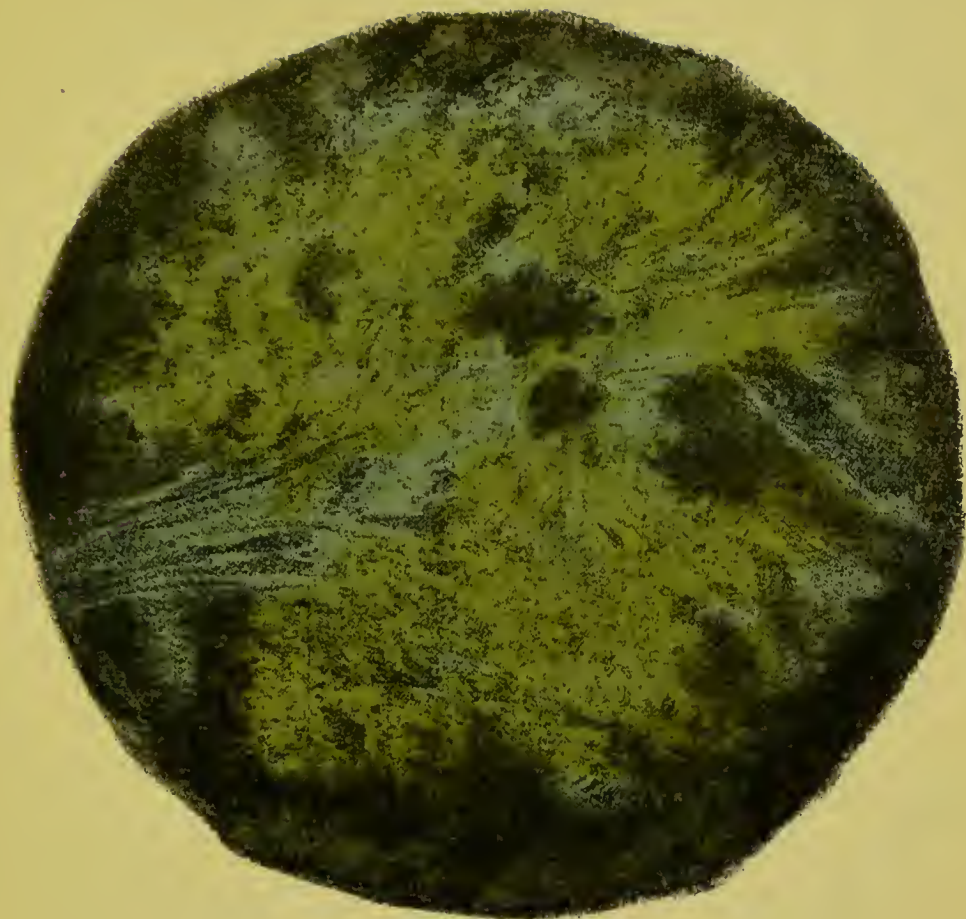
No. 17. Constantinople Opium occurs either in large cakes or in small lenticular masses, weighing from a quarter to half a pound. The masses are generally wrapped in a poppy leaf, with the mid-rib generally placed across the middle of the cake, by which character this kind of opium may be distinguished from Smyrna opium. Constantinople opium is generally considered to be inferior to Smyrna; some specimens, however, contain a large per-centage of morphine.

No. 18. Egyptian Opium occurs in circular cakes, more or less flat, about two or three inches in diameter, and covered with a leaf which is believed to be that of the Oriental Plane. This leaf can be distinguished from the poppy leaf by possessing palmate or radiate venation. Internally this opium is of a reddish colour, and does not darken by keeping, as the other kinds of opium do. It is inferior to either the Smyrna or Constantinople opium.

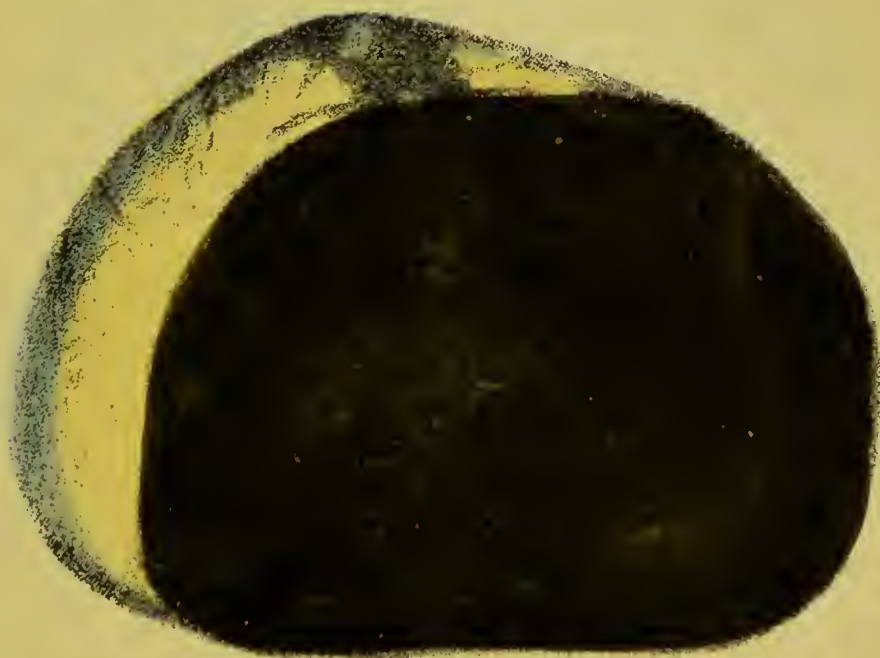
No. 19. Persian or Trebizond Opium comes over but rarely, in sticks wrapped up in paper, about the thickness of the little finger and about six inches in length. This opium is very inferior. Recently opium of a better quality has been imported from Persia in lumps, some specimens of which, forwarded to the author, contain from 12 to 15 per cent. of morphine.

East Indian Opium. *Malwa Opium* occurs very rarely in English commerce. It is met with in the form of hard, circular, flattened cakes, not wrapped in any leaf.

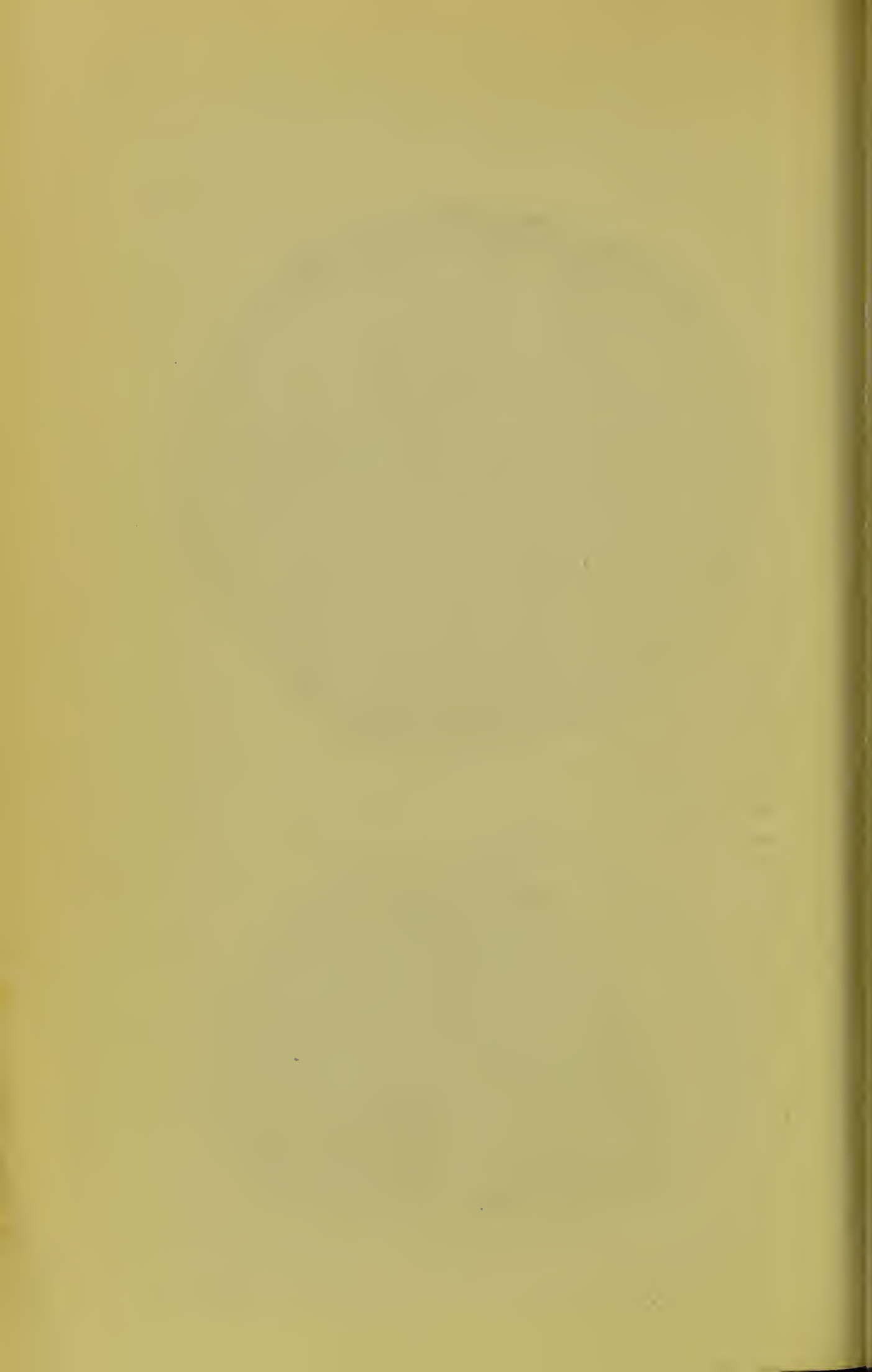
Composition. Morphina, $C_{17}H_{19}NO_3$.—This is the most important of the numerous alkaloids found in opium, the commercial value of which entirely depends upon the per-



N^o 18.



N^o 19.



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centage of morphine it contains. All samples of opium contain morphine, but in varying amounts, the highest recorded percentage being 23. The opiums most sought after for the preparation of this alkaloid are Asia Minor and Persian. The latter, prior to extraction of its morphine, is thoroughly percolated with petroleum ether, to remove the fatty oil added during its manufacture. Morphine is sparingly soluble in absolute alcohol (1 in 15,000). It possesses powerful reducing properties, reducing readily argentic nitrate, alkaline potassic ferricyanide and iodic acid. When treated with an alkaline permanganate of potassium solution it is converted into oxydimorphine.

Colour Reactions of Morphine.

Nitric Acid gives a bright red, changing to yellow.

Ferric Chloride added to solution gives a blue colour.

Sulphomolybdic Acid (Fröhde's reagent) gives an intense violet, changing to purple.

Strong Sulphuric Acid, with a little Sodium arseniate, and gently warming, gives a blue colour, changing to green.

Strong Sulphuric Acid and sugar give a red colour.

Solubilities of Morphine Salts.

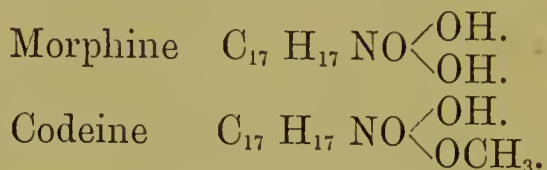
Acetate ...	1 in	$2\frac{1}{2}$	parts of water.	
Tartrate ...	1 „	$9\frac{3}{4}$	„	„
Sulphate ...	1 „	23	„	„
Hydrochloride	1 „	24	„	„
Meconate ...	1 „	34	„	„ (Dott).

When heated in a hermetically sealed tube with zinc chloride it yields apomorphine as a decomposition product. This principle is a powerful emetic.

Codeina, $C_{18}H_{21}NO_3, H_2O$. This alkaloid, which has been isolated from various samples of opium, differs from morphine by its much greater solubility in hot water (1 in 17). It may be extracted from the ammoniacal liquor after the precipitation of morphine by agitating with one half its volume of benzine, in which codeine readily dissolves (1 in 10). Codeine usually occurs in large transparent

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hard crystals, containing $5\frac{1}{2}$ per cent. of water of crystallisation. Some samples of opium yield only minute quantities of this alkaloid; but occasionally, as much as .4 to .5 per cent. has been obtained. According to Gerichten and Schrötter, Codeine is the mono-methyl ether of morphine, which is shown by the following formula:—



Codeine, when heated with strong sulphuric acid containing a little ferric chloride, develops a fine blue colour (Hesse). On substituting sodium arseniate for ferric chloride, a deeper blue is produced, which, when poured into a solution of sodium hydrate, acquires an orange colour.

Grimaux has succeeded in converting morphine into codeine by treating morphine with caustic soda, and afterwards heating the resulting compound with methylic iodide.

Apocodeina, $\text{C}_{18} \text{H}_{19} \text{NO}_2$. When codeine is heated in a hermetically sealed tube with zincic chloride it loses a molecule of water, and is converted into apocodeine. Apocodeine is much more stable than apomorphine, and differs from that body in giving, with nitric acid, a permanent blood red. Both are powerful emetics.

Narcotina, $\text{C}_{22} \text{H}_{23} \text{NO}_7$. This substance is found in most samples of opium, but in very varying amounts. Some varieties of Persian opium have yielded as much as 10 per cent.; but it is only found in small amount in Smyrna opium. Narcotine may be extracted from opium by percolation with ether, which removes wax and fatty matter as well. The ether is evaporated off, the glutinous residue exhausted with acetic acid, filtered, and slowly evaporated, when the narcotine crystallises out as acetate; which, on addition of hot water, decomposes into free acetic acid, and narcotine, which is precipitated. When oxidised with manganic oxide and sulphuric acid, it is converted into cotarnine and opianic acid.

A solution of narcotine in dilute sulphuric acid on evaporation acquires a fine red colour.

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Narceina, $C_{23}H_{29}NO_9$, occurs in very small quantities in opium, varying from .02 to .71 per cent.

Narceine, when heated with equal proportions of strong sulphuric acid and phenol, first develops a yellow colour, changing to brown; and as the phenol volatilises, a cherry red is produced on the heat being continued, and the addition of a few drops of water transforms it to a dirty yellowish white. (Arnold.)

Thebaine, or *Paramorphina*, $C_{19}H_{21}NO_3$. This principle has been isolated from Smyrna opium by Merck, who obtained 1 per cent. When warmed in contact with Fröhde's reagent it acquires an orange colour. Strong sulphuric acid changes it to a blood red colour.

Accompanying these active principles are a large number of lesser importance, among them being Meconin $C_{10}H_{10}O_4$, Cryptopine $C_{21}H_{23}NO_5$, Laudanine $C_{20}H_{25}NO_4$, Papaverine $C_{20}H_{21}NO_4$, Rhœadine $C_{21}H_{21}NO_6$.

Meconic Acid, $C_7H_4O_7 \cdot 3H_2O$. This acid is the natural acid found in opium. It is precipitated from its solution on the addition of plumbic acetate, or calcic chloride. On suspending the plumbic meconate in water and decomposing with a current of sulphuretted hydrogen gas, the free meconic acid remains in solution, which, on evaporating by the aid of a water bath to a small bulk, crystallises out in pearly scales. Its solution gives a blood-red colour with neutral ferric chloride. It is readily soluble in amyl alcohol. The construction of this acid is most probably that of an oxy-dibasic acid, and not tribasic as stated. (Memel.)

When heated it first yields comenic, and finally pyrocomenic acids.

Lactic Acid is found in opium, and is supposed to be a product of the fermentation which takes place on drying the masses.

Separation of the opium alkaloids. The following method, devised by Plugge, is a very satisfactory one for estimating the six most important alkaloids in opium. The opium is exhausted with water containing a little

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hydrochloric acid which forms hydrochlorates ; to this solution a quantity of a concentrated solution of sodium acetate is added and allowed to remain for 24 hours, then filtered. The precipitate consists of narcotine and papaverine, and the filtrate contains narceine, thebaine, codeine, and morphine. The precipitate is washed with a little water, then dissolved in dilute hydrochloric acid, using the least possible quantity, and then diluted so that it contains about .25 per cent. of the alkaloids, when solution of potassium ferricyanide is added and set aside for 24 hours, it precipitates papaverine ferricyanide, which is filtered off, and may be weighed as such, or digested with weak ammonia, and then weighed as alkaloid. The filtrate from the papaverine ferricyanide is now rendered alkaline with ammonia, which precipitates the narcotine ; this is collected, dried, and weighed. The filtrate from the sodium acetate precipitate is now evaporated to a small volume on a water bath, then allowed to stand 24 hours, when the narceine is precipitated as the pure alkaloid ; this is collected on a filter-paper, washed with a little water, dried, and weighed. To the filtrate from the precipitated narceine a strong solution of sodium salicylate is added, and again set aside for 24 hours, when thebaine salicylate crystallises out ; this precipitate is collected on a filter and gently washed with ammonia solution until the washings cease to give any reaction with ferric chloride for salicylates, finally the pure alkaloid is dried and weighed. To the filtrate, hydrochloric acid is added, which precipitates salicylic acid, this precipitate is removed by agitation with chloroform, the solution is concentrated on a water bath and solution of potassium thiocyanate added. After 24 hours the precipitated codeine hydrothiocyanate is collected and weighed as such. To the filtrate, which now contains the morphine, add a little ammonia and agitate with a little chloroform to remove traces of codeine, separate the aqueous layer, acidify with hydrochloric acid, then render alkaline with ammonia and remove the morphine by repeated agitation with amyl alcohol, then evaporate off the alcohol and weigh the residue.

Assay of Opium.—The chief objection to the Pharmacopœia process is that much too long a time is allowed before the

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precipitated morphine is collected; the whole of the alkaloid is precipitated at the end of four hours. More recently other methods have been devised, and they chiefly differ in extracting the opium with water or alcohol at 70° C., precipitating with ammonium hydrate in the presence of alcohol and ether, and finally washing the alkaloid with chloroform; by some the morphine is estimated by means of potassium ferricyanide, then estimating the excess of the ferricyanide; and by others the precipitated alkaloid is titrated with a standard dilute acid solution.

The best way to ascertain the purity of a sample of opium is to estimate the amount of morphine present in it. The following is the method given in the British Pharmacopœia.

Take of powdered opium dried at 212° F. 140 grains, freshly slaked lime 60 grains, chloride of ammonium 40 grains, and a sufficiency of rectified spirit, ether, and distilled water.

Triturate together the opium, lime, and 400 grain-measures of distilled water in a mortar until a uniform mixture results; then add 1000 grain-measures of distilled water, and stir occasionally during half an hour. Filter the mixture through a plaited filter about three inches in diameter into a wide-mouth bottle or stoppered flask (having the capacity of about six fluid ounces and marked at exactly 1040 grain-measures) until the filtrate reaches this mark. To the filtered liquid (representing 100 grains of opium) add 110 grain-measures of rectified spirit and 500 grain-measures of ether, and shake the mixture; then add the chloride of ammonium, shake well and frequently during half an hour, and set it aside for twelve hours. Counterbalance two small filters; place one within the other in a small funnel, and decant the ethereal layer as completely as practicable upon the inner filter. Add 200 grain-measures of ether to the contents of the bottle and rotate it; again decant the ethereal layer upon the filter, and afterwards wash the latter with 100 grain-measures of ether, adding slowly and in portions. Now let the filter dry in the air, and pour upon it the liquid in the bottle in portions, in such a way as to transfer the greater portion of the crystals to the filter. When the fluid has passed

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through the filter, wash the bottle and transfer the remaining crystals to the filter, with several small portions of distilled water, using not much more than 200 grain-measures in all, and distributing the portions evenly upon the filter. Allow the filter to drain, and dry it, first by pressing between sheets of bibulous paper, and afterwards at a temperature between 131° and 140° F., and, finally, at 194° to 212° F. Weigh the crystals in the inner filter, counterbalancing by the outer filter. The crystals should weigh ten grains, or not less than nine and a half and not more than ten and a half grains corresponding to about ten per cent. of morphine in the dry powdered opium.

This process was originally introduced by Dr. Hofmann, and adopted by the United States Pharmacopœia, but its present modified form, as now official, is due to Mr. Conroy, of Liverpool. Various other processes have been proposed by Fluckiger, Petit, Prollius, and Von Perger, but they do not give nearly so true a morphimetric value, on account of the imperfect precipitation of the alkaloid.

Adulterations.—Inferior kinds of opium, and opium from which the morphine has been extracted, have been substituted for good opium. Impurities such as stones, gravel, bullets, &c., have frequently been found mixed with opium. Opium of too soft a consistence should not be used, as the more water there is in a sample, the smaller the percentage of morphine will be.

Therapeutics.—Opium, when taken internally, generally produces at first a stimulating effect on the vascular and nervous system, afterwards producing sleep. In large doses it is a poison, the sleep passing into a condition of coma, followed by death.

Dose— $\frac{1}{2}$ -grain to 3 grains.

Official Preparations :

Codeina.

Confectio Opii.

Emplastrum Opii.

Pilula Ipecacuanhæ cum Scilla.

„ Saponis Composita.

„ Plumbi cum Opio.

Cruciferae.

Enema Opii.	Pulvis Cretæ Aromaticus cum
Extractum Opii.	Opio.
„ Opii Liquidum.	„ Ipecacuanhæ Compositus.
Linimentum Opii.	„ Kino Compositus.
Morphinæ Acetas.	„ Opii Compositus.
„ Acetatis Liquor.	Suppositoria Plumbi Composita.
„ Bimeconatis	Tinctura Opii.
„ Liquor.	„ Camphoræ Composita.
„ Hydrochloratis	„ Opii Ammoniata.
„ Liquor.	Trochisci Opii.
„ Sulphas.	Unguentum Gallæ cum Opio.
	Vinum Opii.

CRUCIFERÆ.**No. 20. Sinapis nigræ semina. *Black Mustard Seeds.***

The dried ripe seeds of *Brassica nigra*. (*Sinapis nigra*.)

Habitat.—Indigenous ; growing in waste places, and cultivated in fields.

Characters.—Black mustard seeds are very small, scarcely half the size of white mustard seeds, roundish, dark reddish, or greyish brown, finely pitted, hard ; internally yellow. They possess no odour when dry, but when triturated with water they exhale a strong pungent odour, due to the formation of volatile oil.

Large quantities of mustard seeds are produced in the Netherlands, whilst Yorkshire and Lincolnshire are the principal counties where they are grown in England.

Composition.—The seeds contain about 25 per cent. of a fixed fatty oil, which yields Oleic, Stearic, and Brassic acids on saponification ; myrosin, an albumenoid ferment ; sinigrin or myronate of potassium ; and mucilaginous matter. When crushed and allowed to remain in contact with water for some time, a species of fermentation (false) takes place, the result of which is the formation of an intensely irritating and vesicating essential oil, acid sulphate of potassium and glucose.

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Myrosin.—This albumenoid body may be extracted from the crushed seed, after extraction of fatty oil and sinigrin, by moistening with water, and then percolating with tepid water, carefully concentrating the solution in vacuo, when it separates out. Myrosin is coagulated at a temperature of 140° . Therefore, when the crushed seeds are treated with boiling water, little or no essential oil is formed. After removal of the fixed oil, the marc is treated with warm strong alcohol, 86 per cent., and the percolate allowed to stand, when the Sinigrin crystallises out; by treating its solution with a small quantity of dilute sulphuric acid, Myronic Acid ($C_{10}H_{19}NS_3O_{10}$) is precipitated. This unstable glucoside is readily resolved by ferments into the essential Oil of Mustard, glucose and bisulphate of potassium. This change, which takes place when water is added to the crushed seeds, is the cause of the pungency developed.

Essential Oil of Mustard (Allyl Thiocarbimide, C_3H_5CNS) may be obtained by careful distillation, after the fermentation has taken place. It is a pale yellow oil with intensely irritating vapour and strong vesicating properties. Sp. Gr. 1.018; when agitated with strong potassium hydrate, it decomposes into potassic sulphide and sinapoline. Very frequently it contains small quantities of carbon bisulphide, which may be detected qualitatively by the xanthogenate of copper reaction, or determined quantitatively by treating it with triethyl phosphine, with which it forms pink crystals of $(C_2H_5)_3PCS_2$. When it is treated with ammonia gas, it forms Thiosinamine, $CSN C_3H_5 + NH_3 = SC \begin{Bmatrix} NH C_3H_5 \\ NH_2 \end{Bmatrix}$ a basic compound, soluble in water, from which it crystallises in prismatic needles.

Essential Oil of Mustard may be prepared artificially by the action of syrupy phosphoric acid on sulphurea, or by the action of ammonium sulphocyanate on allyl iodide.

Pure essential Oil of Mustard, when dissolved in absolute alcohol forms an ultramarine blue precipitate when ammonio-sulphate of copper solution is added, (Hager). Exposed to bright sunlight it deposits sulphur, and forms allyl cyanide.

Sinigrin and essential Oil of Mustard may be roughly

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determined by distilling the crushed seeds with water, and oxidising the distillate with alkaline potassic permanganate, then estimating the sulphuric acid formed as baric sulphate.

The extraction of Sinigrin from the seeds is attended with considerable loss, occasioned by the unstability of the compound. Black mustard yields about 1.6 per cent. of essential oil, and 3 per cent. of nitrogen.

No. 21. Sinapis Albæ Semina. *White Mustard Seeds.*

The dried ripe seeds of *Brassica alba* (*Sinapis alba*).

Habitat.—Indigenous.

White mustard seeds are larger than those of the black mustard. They are of a yellow colour, both externally and internally. They possess a pungent taste, but no odour even when rubbed with water. Flour of mustard consists of the seeds of both black and white mustard crushed, pounded, and afterwards sifted.

The two plants may be distinguished by the following characters: White mustard has hispid spreading siliques, which are short, and are surmounted by a long, compressed, veined beak. Black mustard has smooth siliques, adpressed to the stem, with a short straight beak.

Composition.—White mustard seeds principally differ from the black in not yielding any essential oil, and in containing less sulphur. They contain about 25 per cent. of a fatty oil, which on saponification yields Stearic, Brassic or Erucic, Benic or Behenic, and Oleic acids, also they contain Sinalbin and Myrosin: these in contact with water yield a fixed pungent body called Sulphocyanate of Acrinyl.

Sinalbin, $C_{30}H_{44}N_2S_2O_{16}$, may be extracted by treating the seeds with warm alcohol, after removal of the fatty oil. It deposits from the alcoholic solution in pale yellow needle-shaped crystals. It is readily soluble in water, which, on the addition of caustic soda, developes an intense yellow colour, changing to bright red on addition of nitric acid. Myrosin decomposes it into Glucose, Sinapine acid sulphate, and Sinalbin thiocarbimide, or sulphocyanate of acrinyl.

Argentio nitrate solution precipitates the Sinapine and Sinalbin thiocarbimide, as silver compounds. Sulpho-

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cyanate of acrinyl is the pungent principle; it is a yellow oil, soluble in alcohol or ether, but insoluble in water. The chemical metamorphosis of Sinalbin proves it to be closely allied to Sinigrin.

That the myrosin undergoes a slight change there is no doubt, but it is not understood.

Tests for White or Black Mustard :—

An aqueous extract of white mustard seeds, on addition of neutral ferric chloride, acquires a blood-red coloration; when black mustard is submitted to the same treatment, little or no change takes place.

An aqueous extract of white mustard seeds, on standing for four hours, evolves sulphuretted hydrogen; black mustard solution remains persistently pungent. (Piesse and Stansell.)

Commercial powdered mustard varies considerably in its value; some samples containing added starch and turmeric. It contains, in varying proportions, both black and white mustards.

The seeds are sometimes adulterated with rape-seeds, which can be detected by chewing; they have a bland, oily taste, but no acidity.

The commercial names for the two mustards are, Brown and Yellow.

Therapeutics.—Mustard acts as a powerful stimulant diuretic, and in large doses it possesses emetic properties.

Official Preparations:

Of the Powder—Cataplasma Sinapis; Charta Sinapis.

Of the Black Mustard Seeds—Oleum Sinapis.

Of the Oil—Linimentum Sinapis Co.

No. 22. *Armoraciæ Radix.* Horseradish Root.

The fresh root of *Cochlearia Armoracia*.

Habitat.—Cultivated in Britain and all parts of Europe.

Characters.—Horseradish root is long, cylindrical, of a very light yellow colour externally, and of a white colour



N° 23.



N° 24.
(Peruvian)



N° 24
(Savanilla)



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internally. When cut or scraped it emits a very pungent odour. It is most active in autumn, and in early spring, before the leaves have appeared.

Composition.—The chemical constituents of this root are but imperfectly known. When the root is rasped into fine shavings and submitted to distillation with water, a pungent volatile oil distils over, and the aqueous residuum, on addition of strong alcohol, throws down a flocculent precipitate, probably myrosin. The essential oil which is obtained on distillation does not pre-exist in the root, as can be proved by treatment with ether, when no oil is dissolved out, but only a small amount of fatty matter. Chemically, the oil is identical with that described under black mustard, the root yielding about .008 per cent. It likewise yields, when treated with ammonia gas, Thio-sinamine, which, on further treatment with caustic potash, gives potassium sulphide and sinamine.

Originally this oil was said to be sulphocyanate of butyl, but this does not hold good with its decomposition products.

Therapeutics.—The same as mustard.

Official Preparation.—Spiritus Armoraciæ Compositus.

POLYGALACEÆ.**No. 23. Senegæ Radix. *Senega Root.***

The dried root of Polygala Senega.

Habitat.—British North America and United States.

Characters.—Senega root consists of twisted portions, about the thickness of a quill, attached to a knotty root stock. Each portion has a projecting ridge in the form of a keel, extending throughout its entire length. The activity resides in the cortical portion, the medullium or inner portion being practically inert.

The formation of the keel-shaped ridge, resembling a contorted sinew, is due to the unequal development of the liber tissue.

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Composition.—Senegin or Polygalic Acid, Malic Acid, Virgineic Acid, and Resin, with small amount of a volatile oil.

Senegin is a glucoside, probably identical with Saponin. It may be prepared by concentrating a decoction of the root to a small bulk and adding twice its volume of strong alcohol, filtering, washing the precipitate with alcohol, recovering the spirit by distillation, and precipitating with solution of barium hydrate; collecting the precipitate and suspending it in a little water, and adding dilute sulphuric acid, filtering from precipitated barium sulphate, concentrating by means of a gentle heat, when it separates out. It occurs as an intensely irritating amorphous powder, which on hydrolysis yields sapogenin and glucose. Strong sulphuric acid colours it, first yellow, then red, and ultimately violet. Saponin, when submitted to the same treatment, gives a violet coloration much more rapidly. Senegin is soluble in benzine, petroleum ether, and chloroform. The root yields about 2 per cent. Sapogenin, which is precipitated from the solution after hydrolysis, is not quite pure; it retains minute traces of glucose. This body, when treated with strong sulphuric acid, gives a violet colouration immediately.

Virgineic Acid is a brownish-red oily liquid, having an intensely fetid, disagreeable odour, and bitter, acrid taste, it is readily soluble in ether and alcohol. The root also contains a peculiar yellow colouring matter and a variable amount of sugar.

According to Langbeck, old samples of the root contain methyl, salicylate, and glucose, formed by the gradual metamorphosis of senegin.

Adulterations.—Occasionally other roots have been found admixed with senega, but their occurrence is to be ascribed to carelessness during collection. The more commonly occurring roots are those of *Panax quinquefolium* and the rhizome of *Cypripedium pubescens*. Neither of them can be mistaken for senega. The former is much larger and spindle shaped, with numerous transverse ridges, and the latter darker in colour, and slightly notched; in both there is an absence of the characteristic ridge found on senega.

One of the more modern adulterations is that of the root

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of *Ionidium Ipecacuanha*. It occurs as an undulated root, markedly wrinkled with deep transverse cracks, exposing a yellowish medullium; externally it has a grey colour. The rhizome of *Asclepias Vincetoxicum* has also been found. It may be distinguished by its yellow centre and evident pith, by the scars of the stems, and the very slight taste. More recently the root of *Polygala Boykinii* has been substituted. This root has no keel, otherwise it closely resembles true senega. It yields 3 per cent. of Senegin.

Therapeutics.—Senega root possesses diaphoretic, diuretic, and expectorant properties.

Official Preparations.—*Infusum Senegæ*; *Tinctura Senegæ*.

No. 24.—*Krameria Radix.* *Rhatany Root.*

The dried root of *Krameria triandra* (Peruvian Rhatany) and *Krameria Ixina* (Savanilla Rhatany).

Habitat.—The eastern coasts of South America.

Characters.—Peruvian Rhatany is in branched or unbranched pieces, varying in length and thickness. It consists of a readily separable bark, which varies in thickness from one-twentieth to one-tenth of an inch, rough and scaly, except in the smaller pieces, dark reddish-brown externally, and bright brownish-red on its inner surface; and of a hard brownish or reddish-yellow woody axis.

Savanilla Rhatany is less irregular and knotty, and not so long or thick as Peruvian. It is well characterised by its pale purple colour, and its smooth and thicker bark, which adheres firmly to the wood beneath, and is usually marked at irregular intervals by deep transverse cracks. The bark of both kinds has a strongly astringent taste; and when chewed tinges the saliva red, but it has no marked odour. The wood is nearly tasteless and inodorous.

The root of *Krameria Ixina* may be distinguished from that of *Krameria triandra* by the fact that the bark adheres closely, is transversely cracked, and has not a fibrous character.

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In powder the two roots may be distinguished by agitating with water and reduced iron, allowing it to stand, and then filtering. The *K. triandra* filtrate will present a dirty brown colour, whereas the *K. Ixina* will possess an intense violet colour.

Composition.—Rhatania-tannic Acid, Rhatania Red, gum, and sugar.

Rhatania-tannic Acid occurs as an amorphous powder. Its solution in water gives a dark green precipitate with neutral ferric chloride. Raabe, who has carefully examined this body, states that it is not a glucosidal tannin. To prepare this acid in a pure condition the crude acid is dissolved in tepid water, and then a solution of sodium chloride added, finally extracting by shaking with acetic ether, decanting the super-stratum, and recovering the acetic ether by distillation. On treatment with hydrolytic agents it yields Rhatania-red. This body is also found in the root bark, most likely as a bi-product in the physico-chemical metamorphosis of the plant tissue.

Rhatania-red is a dark red amorphous powder, but very slightly soluble in water. In dry distillation it yields pyrocatechin a diatomic phenol, $C_6H_4(OH)_2$, and on fusing with caustic soda it yields protocatechuic acid, $C_6H_3(OH)_2COOH$, and phloroglucin, $C_6H_3(OH)_3$. This is a common reaction with many astringent bodies.

Krameria triandra root when exhausted with cold water yields 10.5 per cent., and by decoction 18.5 per cent. of extract.

Krameria Ixina root when similarly treated yields 14.75 and 20.5 per cent. respectively.

The root yields from 15 to 25 per cent. of Rhatania-tannic acid, and about 20 per cent. Rhatania-red.

The commercial South American "Extract of Rhatany," used for tanning purposes, is probably not made from Rhatany, but from *Ferreiria spectabilis*, a Leguminous tree, indigenous to Brazil.

The root of *Krameria argentea* is frequently met with; it may be distinguished by its darker colour, and also by its occurring in long flexible pieces with a largely developed

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cortex, which is frequently fissured by deep transverse cracks.

Therapeutics.—A powerful astringent.

Official Preparations.—Extractum Krameriaë; Infusum Krameriaë; Pulvis Catechu Compositus; Tinctura Krameriaë.

LINACEÆ.**No. 25. Lini Semina. Linseed.**

The dried ripe seeds of *Linum usitatissimum*, (*common flax*.)

Habitat.—Probably a native of Southern Europe. It is cultivated in most countries.

The fruit is an ovate or globular capsule composed of five carpels, and is five-celled, each cell containing two seeds.

The Seeds are principally imported from the Russian ports and Germany, also from Holland, the south of Europe, and India. They are inodorous, and have a mucilaginous and slightly bitter taste.

Composition.—Fixed oil, and mucilage.

Fixed Oil.—This oil is prepared on a large scale, and two processes are adopted. First: The oil is expressed from the seeds in their natural condition. Second: The seeds are dried previously to expression. The oil obtained by cold pressure is much lighter in colour, being of a very pale yellow, neutral to litmus, and devoid of an acrid taste, but as generally found the oil is of a brownish colour, much thicker, with a disagreeable odour and pungent taste. The yield of oil by cold pressure is about 25 per cent., but when heat is employed as much as 35 to 40 per cent. is obtained. Numerous samples give the Sp. Gr. .941, but it varies considerably from .921 to .951. When agitated with six times its volume of absolute alcohol, it dissolves. When agitated with 84 per cent. spirit, it imparts a faint yellow colour, and dissolves when 43 times its volume has been added. It is miscible in all proportions with carbon bisulphide, chloroform, and turpentine. When saponified

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with alcoholic soda solution it yields a soap, which when isolated is of a soft consistency.

On agitating the oil with acid solution of mercury nitrate, it acquires a yellowish-orange colour; and when treated with sulphuric acid and potassic bichromate, it gives a dirty green colour.

When heated it first boils at 265° F., and the boiling point is gradually increased until it has lost 8 per cent. of its weight, when it remains constant, at 270° F.

Linseed oil consists of a mixture of the glycerides of Linoleic, Myristic, Oleic, and Palmitic acids. Linoleic acid, $C_{18}H_{34}O_2$, when separated, is colourless; soluble in ether and alcohol; and, on passing a current of warm air over it becomes converted, first into the hydrate of oxylinoleic acid, $C_{18}H_{32}O_4$, and, finally, into a resinous body, linoxyn, $C_{32}H_{54}O_{11}$, a substance insoluble in ether. This same change takes place when the oil is exposed to the air. When linseed oil is mixed with litharge or zinc chloride, and boiled for some time, and the oil decanted, this change on exposure becomes more rapid, the oil being then known as boiled oil.

Colour reactions of Linseed Oil.

Calcium bisulphide	forms a yellowish green emulsion.
Sulphuric acid, Sp. gr. 1.53	...	...	Dark, dirty green.
Nitrosulphuric Acid	...	...	Reddish brown.
Nitric acid, Sp. gr. 1.22	...	...	Yellow.
Stannic Chloride	...	...	Dirty yellow.

Linseed oil, when treated with sulphuric acid in the proportion of 5 of oil to 1 of acid, gives a considerable rise in temperature, starting from 14° C. to 132° C. (Casselman). When submitted to the elaidin test (acid solution of mercury nitrate), it does not solidify. Agitated with an equal volume of hydrogen peroxide, free fatty acid soon separates. (Chone.)

Mucilage. This body is easily extracted by treating the seeds with warm water. It can be separated into two

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portions, one soluble in water, the other insoluble. The soluble portion is identical with arabin, and yields 16 per cent. of mucic acid, and a little oxalic acid when treated with nitric acid.

The insoluble portion is a nitrogenous principle, and not a true gum, and constitutes 30 per cent. of the mucilage.

Linseed Meal, when moistened with warm water and allowed to stand, undergoes a fermentation, and the product submitted to distillation yields hydrocyanic acid.

The Linseed Meal now official contains variable proportions of oil, as the oil slowly resinifies on exposure to air.

Adulterations.

(a) *Linseed.* A large number of smaller seeds are frequently found mixed with Linseed; they are principally cruciferous and caryophyllaceous. When crushed and treated with water, such a farina may be recognised by its pungency. An easy method to separate these seeds is to pass the linseed through sieves of different forms; the smaller seeds can then be examined.

(b) Linseed Oil.

This oil is largely submitted to sophistication, the principal adulterants being —

1. Fatty, non-drying oils. 2. Rosin oil. 3. Petroleum oils.

1. *Fatty oils*, when present, will yield different amounts of free fatty acids, and alter the colour reactions of the pure oil.

2. *Rosin oil.* If present, the sp. gr. will be lower, the oil will be more inflammable, and the boiling point considerably diminished, rosin oil boiling at 174° F.

3. *Petroleum and mineral oils.* These oils can be detected by the following process:—The oil is first saponified with alcoholic soda, and the soap mixed with sand, and treated with light petroleum spirit, the percolate distilled at a temperature not

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exceeding 220° F. until all the spirit distils over. The residue will be the amount of mineral oil added. (Thomson.) By this process, as much as 26 per cent. of added oil has been detected.

Another method is to note the flashing point. Genuine oil flashes at 282° C. Sometimes it is found to flash at 180° C., proving the presence of more easily inflammable oil.

Flax is prepared from the liber or inner bark of the plant.

Tow consists of the short threads separated during the combing of flax.

Linen is made from flax, and *lint* is linen the surface of which has been scraped.

Therapeutics.—An emollient and demulcent.

Official Preparations.—Farina Lini; Infusum Lini; Oleum Lini.

MALVACEÆ.**No. 26. Gossypium. Cotton Wool.**

The hairs of the seeds of *Gossypium barbadense* and other species of *Gossypium*, from which fatty matter and all foreign impurities have been removed.

Habitat.—Egypt, India, and cultivated in America.

Characters.—Cotton wool consists of the fine hairs found firmly adherent to the testa of the seed, from which they are removed by machinery, and then carded; a little oil being added during the latter part of the process. Microscopically examined, the hairs are found to consist of simple cells, with thin walls, and appear as twisted, hollow bands, thickened at the edges.

Composition.—Cotton wool is nearly pure cellulose, is indorous and innutritious, insoluble in ordinary solvents, but when freed from oil it dissolves in ammonio-sulphate of copper solution, and in strong alkaline solutions, from which it is precipitated on the addition of mineral acid in

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colourless flakes. Iodine colours it brown, but when treated with zinc-chloride and iodine it gives a blue colour. Nitric acid converts it finally into oxalic acid, but first forms nitro compounds, and probably mucic acid. Strong sulphuric acid dissolves it, forming sulpho-lignic acid, and a body homologous with dextrin; boiled with dilute sulphuric acid it is hydrolised, yielding glucose. When the gaseous haloid acids are passed through moistened cotton wool it is converted into hydro-cellulose. Nitro-sulphuric acid forms nitro substitution compounds, in which one or more hydrogen atoms are replaced by nitryl (NO_2).

No. 1. Trinitro-cellulose, $\text{C}_6 \text{H}_7 (\text{NO}_2)_3 \text{O}_5$. Insoluble in ether and alcohol, but soluble in ethyl acetate.

No. 2. Dinitro-cellulose, $\text{C}_6 \text{H}_8 (\text{NO}_2)_2 \text{O}_5$. Insoluble in glacial acetic acid, but soluble in ether and alcohol.

No. 3. Mononitro-cellulose, $\text{C}_6 \text{H}_9 (\text{NO}_2) \text{O}_5$. Soluble in glacial acetic acid.

The first is the most explosive, and is the one used in blasting operations, as gun cotton.

Paracellulose, Metacellulose, Cutose, Pectose and Vasculose are bodies probably isomeric with cellulose, the difference in their characters and behaviour with sulphuric acid being probably due to the elements of water being chemically combined with them.

Gossypium Depuratum.

Pure Cellulose, Absorbent Cotton Wool.

Is prepared by first boiling the wool with weak alkali solution, and well washing to remove the soap formed, then treating with dilute hydrochloric acid, and finally treating a second time with weak alkali, well washing and drying. Treated by this process cotton wool loses nearly 10 per cent. by weight, representing fatty oil. On incinerating a sample it leaves from .65 to .82 of ash.

*Malvaceæ.***Gossypii Semina.** *Cotton Seeds.*

The seeds are from 3 to 4 lines in length, of an irregular ovoid form, with a hard, brittle testa, of a brownish colour, with a prominent raphe running its entire length. Embryo small, of a white colour, with large folded cotyledons, having numerous resin glands imbedded in its mass.

Oleum Gossypii Seminis.

The seeds are gently crushed and the testa removed by winnowing. Then the embryo is submitted to pressure between warm rollers. The seeds yield about 25 per cent. of an oil having a deep brown colour, and containing a considerable amount of albuminous matter, from which it is purified by treating with boiling water and filtering, when the oil which separates is of a much lighter colour. Finally it is treated with a small quantity of soda, and heated. The oil which then separates has a pale colour.

Chemical Composition.—Cotton seed oil consists of the glycerides of palmitic and oleic acids, with a small quantity of a light yellow hydrocarbon. The purified oil is quite transparent, of a pale straw yellow colour, and is neutral to litmus. Sp. gr. .927. On exposure to the air it thickens, and when exposed to extreme cold deposits crystals of palmitin. When agitated with an equal bulk of liquor plumbi subacetatis it develops a red or pink colour. (Bradford.)

Colour Reactions of Cotton Seed Oil.

Strong sulphuric acid	...	{ Violet colour, increased on stirring, afterwards becoming thick and deep brown.
Sulphuric acid and potassic bichromate		{ Violet, changing to blood red, evolving sulphurous anhydride.
Pure nitric acid, 1.40	...	{ Golden yellow, changing to coffee brown
Acid solution of mercuric nitrate		{ Dark orange red, becoming paler.

Sterculiaceæ or Byttneriaceæ.

Submitted to the elaidin reaction it leaves a yellowish mass, which after a time becomes darker in colour.

The oil is easily saponified with an alkali, and on standing, the light yellow neutral hydrocarbon separates, which is taken up by benzine or chloroform.

Official Preparation.—Pyroxylin.

STERCULIACEÆ or BYTTNERIACEÆ.**No. 27. Theobromatis Semina.** *Cacao, Cacao Nibs.*

The crushed and roasted seeds of the Theobroma Cacao, a tree growing to a height of 30 to 40 feet.

Habitat.—Tropical South America and Mexico.

Characters.—The seeds are contained in a large fruit, about 6 to 9 inches long, which is five-celled, and has a thick, tough rind, and in the ripe condition is of a reddish yellow colour. The seeds range from $\frac{1}{2}$ to 1 inch in length, are generally oblong or ovate, and of a brownish-red colour, and are anatropous. The testa is papery and easily removed. Embryo small, with large oily crumpled cotyledons. Taste aromatic, oily, and slightly bitter.

Chemical Composition.—Fatty oil, 38 to 52 per cent.; Theobromine, 1.2 to 4.8 per cent.; Cacao-Red; volatile oil; and starch.

Theobromine, ($C_7H_8N_4O_2$). This alkaloid can be obtained from a decolorised decoction of the seeds, by evaporating to dryness in a water bath, and exhausting with 90 per cent. alcohol, decanting the alcoholic solution, and allowing to stand, when it crystallises out. Theobromine, which is dimethyl-xanthine, is readily converted into caffeine, or trimethyl-xanthine, by acting on the argentic compound of theobromine with methyl iodide, and treating the residue with spirit, from which it crystallises out.

Volatile oil occurs in minute proportions, and imparts the aromatic odour to the seeds.

Use.—Dietetic purposes.

Sterculiaceæ or Byttneriaceæ.

No. 28. Oleum Theobromatis. *Oil of Theobroma.*
Cacao Butter.

Characters.—Of the consistency of tallow, colour yellowish; odour resembling that of chocolate; taste bland and agreeable; fracture clean, presenting no appearance of foreign matter. Does not become rancid from exposure to the air. It usually melts at temperatures between 86° and 95° F. Sp. gr. .948 to .980.

Preparation.—In the preparation of cocoa, or chocolate, a portion, or in some cases nearly the whole, of the fatty oil is removed by hot pressure. The crushed seeds are passed between hot iron or steel rollers, and the liquid oil is collected in a vessel; it is then remelted, strained, poured into moulds, and allowed to solidify. By this process only a portion of the oil is obtained, the usual average in operating on large quantities being from 40 to 45 per cent.

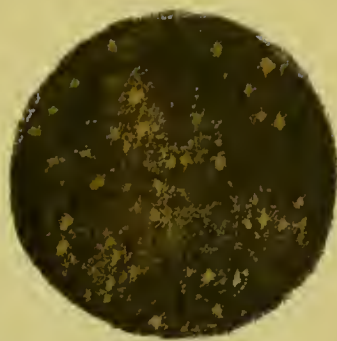
Chemical Composition.—This fat is composed of the glycerides of a number of acids, the principal being stearic and oleic, with small quantity of palmitic, and according to Traub, arachic and lauric acids.

Adulterations.—Tallow seems to be the principal sophisticating agent. The melting point and specific gravity do not give satisfactory evidence of this substance. The following method of Ramsperger gives good results: One part of the oil is dissolved in two parts of absolute ether, and the solution immersed in water at 32° F., pure cacao butter will gradually separate out in granular particles during six minutes; if it contains any foreign fat a cloudiness occurs instantly, and the liquid remains cloudy. On removing the tube from the cold water, and placing it in a vessel of water at 60° F., the solution will become perfectly clear if the oil is pure, but not so if sophisticated.

Official Preparations:—
Suppositoria Acidi Tannici.
,, Hydrargyri.
,, Iodoformi.
,, Morphinæ.
,, Plumbi Composita.



N^o 29.



N^o 29. Section.



N^o 31. Section.

SAPINDACEÆ.**No. 29. Guarana. *Brazilian Cocoa.***

The seeds of *Paullinia sorbilis*, ground and made into a paste with water, and then moulded into cylindrical masses, and dried by exposure to the sun, or by artificial heat.

Habitat.—Found in the west and north of Brazil.

Characters.—Generally occurs in long cylindrical masses, sometimes in round cakes, with a rough surface, and dark, reddish-brown colour. When cut it presents a shining surface, and yields a light powder on grinding. An infusion has a chocolate-like odour and taste, but is somewhat bitter and astringent.

Chemical Composition.—Tannin, guaranine or caffeine, starch, and a coloured fat.

The Caffeine, $C_8H_{10}N_4O_2H_2O$, varies in percentage from 3.2 to 5. It has been isolated by the process used in the preparation of Theobromine.

The tannin, sometimes called paullinotannic acid, gives a green precipitate with ferric salts, but no precipitate with potassio-tartrate of antimony. It also precipitates gelatine and many alkaloids from solution.

Therapeutics.—Given in facial neuralgia, combined with quinine sulphate, and for sick headache.

CAMELLIACEÆ or TERNSTRÆMIACEÆ.**No. 30. Thea. *Tea.***

The dried and prepared leaves of *Camellia Thea* and its cultivated varieties.

Habitat.—China, India, and Ceylon.

Preparation.—The leaves are carefully collected, and, according to the variety of tea that is to be prepared, are submitted to different methods of drying.

Green Teas.—The leaves are slightly heated, when they acquire this peculiar colour, and are then rolled separately in small heaps, and quickly dried.

Camelliaceæ or Ternstroemiaceæ.

Black Teas.—In this case, the leaves, after collection, are exposed for some time, and made into heaps to ferment, after which they are exposed to a small fire, rolled on tables, and dried. Various methods are resorted to in flavouring and colouring teas.

Characters.—Commercially, teas are more or less broken and twisted; but for examination it is preferable to macerate them in water for some time, and then carefully unfold them. The leaves vary in length from 1 to 3 inches, tapering to a fine point at both ends, and are irregularly toothed at the margins, and short stalked.

Chemical Composition.—Tannic and boheic acid, and theine or caffeine. The tannic acid of tea leaves has been stated to be different from that of galls, but this is not quite correct. This tannin, lately examined by Hlasiwitz, has been proved to be the same as gallotannic acid, and is accompanied by a little gallic acid. It is precipitated by basic acetate of lead from infusion of tea leaves, and is separated from the lead by a current of sulphuretted hydrogen.

Boheic Acid, $C_7H_{10}O_6$, is left in solution after precipitation of the tannic acid, and can be obtained by adding an excess of ammonia, collecting the precipitate, and suspending in water, and decomposing with sulphuretted hydrogen, filtering, and carefully evaporating in a water bath. It is amorphous, deliquescent, and of a pale yellow colour. Its alcoholic solution gives a brown colour with ferric chloride.

Theine or Caffeine, $C_8H_{10}N_4O_2H_2O$. This alkaloid may be obtained by carefully heating the finely powdered and dried leaves, when it sublimes; the best method is the one used in the assay of tea samples. A decoction is made with diluted sulphuric acid, and filtered, and to the filtrate magnesium oxide added until it has an alkaline reaction. It is then evaporated to dryness in a water bath, and the residue thoroughly exhausted by ether or chloroform. The percolate is evaporated to dryness and weighed. The yield of theine varies from .8 to 4.5 per cent.

Aurantiacæ.

The leaves when incinerated leave from 4 to 6 per cent. of ash, of which nearly one half is soluble in water.

Preparation.—Caffeina.

AURANTIACEÆ.**No. 31. Aurantii Amari Cortex.** *Bitter Orange Peel.*

The dried outer part of the rind or pericarp of *Citrus vulgaris* (*Citrus Bigaradia*).

Habitat.—A native of Northern India; the varieties are largely cultivated in Spain, France, Algeria, Malta, Jaffa, Mexico, Florida, and the West Indian Islands.

Characters.—Orange peel is best prepared by hand-cutting, and as much as possible of the white spongy parenchyma removed, and carefully dried. It usually occurs in narrow strips or curled bands, rough, glandular, and of a dark orange red colour, white within, the outer portion having a large number of oil cells. It has an aromatic, agreeable odour, and bitter taste. There are two varieties of dried orange peel to be found in commerce: home hand-cut peel and Maltese peel. The former is the better, and should alone be used in pharmacopœial preparations. The Maltese peel is cut very thin, and very frequently torrefied to darken its colour; occasionally charred pieces are found resulting from overheating. It is much less aromatic, and has a feebly bitter taste, compared with the hand-cut peel.

Chemical Composition.—Essential oil, hesperidin, gum, resin, and calcium salts of organic acids.

Hesperidin, $C_{22} H_{26} O_{12}$, is the bitter principle of the peel. It is soluble in ammonia and alcohol, and can be extracted as follows:—The peel is digested with a solution of ammonia (·880) for forty-eight hours, filtered, and neutralised by sulphuric acid. The solution is evaporated to dryness in a water-bath, and treated with boiling absolute alcohol, filtered, and allowed to stand, when it crystallises out in white needles. On hydrolysis it yields hesperidin sugar, and hesperetin. On adding a little caustic potash and drying, then moistening with strong sulphuric acid, it gives a red colour.

*Aurantiacea.***Essential Oil.** *Oleum Aurantii Corticis.*

This oil is prepared by the Écuelle process from the ripened fruit, or the freshly removed peel is twisted, by which the oil cells are burst, and discharge their contents on to sponges, which, when saturated, are wrung, the contents being collected in a basin, and filtered.

There are two varieties of essential oil of orange, one derived from the bitter and one from the sweet orange. The oil from the former is known as *Essence de Bigarade*, and that from the latter is known as *Essence de Portugal*. The oil from the bitter orange is more readily affected on exposure to air. In composition they are chemically alike. The sp. gr. varies from .835 to .887. The oil is dextro-rotary to polarized light.

The oil contains a neutral hydrocarbon, Hesperidene, $C_{10}H_{16}$, and an oxygenated body, $C_{10}H_{16}O$; the latter is the greasy portion which separates out from old samples of oil. It is called bergaptene when obtained from oil of Bergamot, and citroptene when procured from oil of Lemon or Citron. The oils obtained from the fruits of plants of this natural order are generally termed citrenes. Although isomeric with terpenes, they differ in having a higher boiling point, and in forming a dihydrochloride with hydrochloric acid gas. In old samples a non-volatile resin is always found.

Therapeutics.—Stomachic and tonic.

Official Preparations.

Infusum Aurantii.		
„	„	Compositum.
„	Gentianæ	„
Tinctura Aurantii.		
„	„	Recentis.
„	Gentianæ	Composita.
„	Cinchonæ	Composita.
Spiritus Armoraciæ Compositus.		
Syrupus Aurantii Floris.		
Vinum Aurantii.		

*Aurantiaceæ.***Aurantia Immatura.** *Orange Berries.*

These are the unripe fruits which fall from the tree, and are known as Petits Grains ; they are of a greenish colour, and have an agreeable aromatic odour. They contain from 5 to 8 per cent. of hesperidin. True Essence de Petit Grain is obtained by distilling the berries with water, and separating the volatile oil.

Oleum Aurantii Foliorum.

This oil is commercial Essence de Petit Grain, prepared by distilling the leaves with water.

Aurantii Flores.

The flowers are produced in the axils of the leaves, and are of a delicate white colour and fragrant odour.

Oleum Neroli. *Oleum Aurantii Florum.*

Is obtained by distilling the flowers with water, and separating the oil. The residual water is official as Aqua Aurantii Floris.

All the oils are chemically alike in their composition, but differ in their odour and specific gravity.

Orange Flower Water is rarely prepared in this country. It is principally imported from France. As it is imported in large copper bottles, it may contain traces of that metal, which may be detected by sulphuretted hydrogen.

Aurantii Fructus.

The fresh ripe fruit of *Citrus vulgaris*.

The peel is official for Tinctura Aurantii Recentis.

The fruit is a hesperidium, having the epicarp and mesocarp united to form the rind, the endocarp dividing the pulp into wedge-shaped lobes. This fruit is of a deeper colour than the sweet orange, and rougher externally.

Aurantiaceæ.

No. 32. Limonis Cortex. Lemon Peel.

The outer part of the rind or pericarp of the fresh fruit of *Citrus Limonum*.

Habitat.—A native of Northern India, cultivated on the shores of the Mediterranean.

Characters.—Pale-yellow and more or less rough on the outer surface, from the presence of glands containing volatile oil, which are imbedded in the tissue beneath; and having but a very small amount of white spongy portion of the rind on its inner surface. Odour strong, peculiar, and fragrant; taste warm, aromatic, and bitter.

Prepared in the same manner as Orange Peel.

Chemical Composition.—Hesperidin, essential oil, gum.

Preparations.—Essential Oil of Lemon, Essence of Lemon.

There are two methods employed in preparing this important oil: 1st. The sponge process: The operator removes the peel from the unripe fruit in three slices, leaving most of the pulp, then, having collected a sufficiency of peel, he places a sponge in the palm of his left hand, wrapping it round his forefinger; he then places on the sponge one of the slices of the peel, the outer surface next the sponge, and exerts a strong pressure, by which the oil-cells are burst and discharge their contents on the sponge; this is afterwards wrung into an earthen vessel, and the oil which separates from the juice is collected and filtered. 2nd. The *Écuelle* process: The operator has a shallow vessel, having fixed on its bottom a number of sharp points, about half an inch in length, the centre of the bottom being depressed into a tube about 6 inches long, and closed at one end by a stopper. Such a vessel is called an “*Écuelle à piquer*.” This vessel is fixed on a stand, and the operator draws the lemon over the sharp points, exercising at the same time a little pressure; the oil, as it exudes, runs into the tube, and is afterwards removed, separated from watery liquid, and filtered. This mode of extracting essential oils from fruits is now carried on to a large extent; such oils are named *Écuelled Oils*.



Nº 32



Nº 32 Section



Nº 33.



Nº 33. Section.

Aurantiaceæ.

The residual peel from both processes is afterwards distilled with water, by which an inferior oil is obtained, which is frequently used to dilute the superior oils.

Oil of Lemon has a pale yellow colour, is fragrant and aromatic, and has a bitterish taste; it is readily soluble in carbon bisulphide, sparingly in alcohol .838. On keeping it becomes muddy, and acquires a terebinthinate odour. Sp. gr. .836 to .860. It contains a neutral hydrocarbon, citrene, and a minute quantity of citroptene and cymene.

Adulteration.—This oil is frequently submitted to sophistication, either with rectified turpentine (Camphene) or the oil distilled from the residual peel; they are most difficult of detection.

No. 33. Belæ Fructus. Bael Fruit.

The dried half-ripe fruit of *Ægle Marmelos*, the Indian Bael or Bengal Quince.

Habitat.—Malabar and Coromandel; but cultivated to a considerable extent throughout India and Ceylon.

Characters.—Fruit roundish, about the size of a large orange, with a hard woody nearly smooth rind; usually imported in dried slices more or less twisted, or in fragments consisting of portions of the rind and adherent dried pulp and seeds. Rind about one-eighth of an inch thick, hard, and covered with a nearly smooth pale brown or greyish firmly adherent epicarp; the pulp firm and brittle, and of an orange-brown or cherry-red colour externally, but when broken it is seen to be nearly colourless internally. It has no odour, and its taste is simply mucilaginous, and very slightly acid.

Chemical Composition.—No satisfactory analysis of Bael fruit has been made. The rind contains much mucilaginous and pectinose matter, and in the unripe condition is said not to contain any tannin. Collas states that the ripe fruit contains 5 per cent. of tannin; but this is doubtful. The infusion is scarcely affected by iron salts.

Substitutes.—The hesperidium of *Feronia Elephantum* or Wood Apple is used in India in a similar manner to bael,

Canellaceæ.

but is distinguished by being a unilocular fruit with a five-lobed cavity and numerous seeds. The fruit of the Mangosteen (*Garcinia Mangostana*), a native of Malacca, is also largely eaten in India, as well as the fruits of other species of *Garcinia*. The Mangosteen has a softer rind, and is of a darker colour; at its apex there are five sessile radiating stigmas which easily distinguish it.

The rind of the Pomegranate is sometimes met with; it is readily distinguished by being much thinner, of a darker colour externally, and a peculiar greenish-yellow colour internally, and when rubbed on a piece of white paper moistened with water, will leave a yellow stain.

Therapeutics.—Used in diarrhœa and dysentery.

Official Preparation.—*Extractum Belæ Liquidum.*

CANELLACEÆ.**No. 34. Canellæ Cortex.** *White Wood or Wild Cinnamon.*

The bark of *Canella alba* (*Winterania Canella*) deprived of its suberous layer and dried.

Habitat.—Bahama Islands (from which it is imported), Florida, and West Indian Islands.

Characters.—In quills or irregular pieces which are generally more or less twisted and broken longitudinally; it has a pale orange-brown or buff colour externally, is commonly marked by roundish depressions or scars, and sometimes the remains of the corky layer may be seen here and there as silvery grey patches; internally its colour is paler, being whitish or yellowish-white. It has an agreeable odour somewhat resembling a mixture of cloves and cinnamon, and a pungent, bitter, acrid taste.

The quills vary in length from 1 to 3 feet, with bright reddish markings of resin cells.

Preparation.—Prior to removing the bark from the tree, it is gently beaten, after which the suberous layer falls off, and the inner bark is removed; it is then exposed in trays and dried by the sun's heat.

Guttiferae.

Chemical Composition.—The bark contains a bitter principle which has not yet been isolated in a pure condition, resin, mucilage, and a volatile oil. This latter has been obtained to the extent of .74 per cent., which was examined by Meyer and Von Reiche, who, by fractionating it, separated four distinct oils, namely, eugenol or eugenic acid, an oil identical with cajeputene; the two other fractions were not further examined.

The substance called canellin by Petroz and Robinet is now known to be maunite.

Substitution.—The bark of another canellaceous tree has been used, namely, *Cinnamodendron corticosum*; this bark is much darker in colour and not white on its inner surface. It contains a small amount of tannin, but agrees in its aromatic properties. Both barks have occasionally been used for Winter's bark, and the bark which is now found in commerce under that name is mainly derived from *Cinnamodendron corticosum*.

Therapeutics.—An aromatic tonic.

Official Preparation.—*Vinum Rhei*.

The powder called *Hiera Picra* consists of powdered aloes and *Canella* bark.

GUTTIFERÆ.**No. 35. *Cambogia*. *Gamboge*.**

A gum-resin obtained from *Garcinia Hanburii* (*Garcinia Morella*, var. *pedicellata*).

Habitat.—Siam, Cochin China, Southern India, and Ceylon.

Characters.—In cylindrical solid or hollow rolls, longitudinally striated on the surface, and either distinct or more or less agglutinated or folded together into masses; breaking with a conchoidal fracture, the fractured surface being opaque, smooth, glistening, and of a uniform reddish-yellow

Guttiferae.

colour; powder bright yellow; no odour; taste very acrid. When rubbed with water it forms a yellow emulsion; it is completely dissolved by the successive action of rectified spirit and water; and an emulsion made with boiling water and cooled does not become green on addition of solution of iodine.

Collection.—A spiral incision is made into the trunk of the tree, and a bamboo cane inserted at the end, when the latex gradually flows for a considerable length of time. After this the canes are allowed to hang for some time, when the yellow juice gradually hardens, and is then removed, having longitudinal furrows caused by the ridges inside the bamboo.

Cake or Lump Gamboge is that portion of the latex which exudes from the broken twigs and leaves, and generally is of a coarser quality, being mixed with rice-flour, earth, and powered bark. The latex is principally secreted in the numerous ducts of the mesophlœum, and in the dotted vessels of the young wood, flowers, fruit, and leaves.

Chemical Composition.—Resin, gum, and about 5 per cent. of moisture.

The *Resin* is named Cambogic Acid. In a sample of pipe gamboge lately examined, 78 per cent. of this body, which is readily soluble in ether, alcohol and chloroform, was obtained, and when treated with sodium hydroxide solution it gave a beautiful dark red colour; it is precipitated as an amorphous yellow powder by hydrochloric acid. Its alkaline solution gives a beautiful yellow precipitate with the acetates of zinc and lead, and a brownish-yellow with ferric sulphate. It dissolves in strong sulphuric acid, forming a clear yellow solution. Fused with caustic soda, it yields, amongst other substances, phloroglucin and pyrotartaric acid.

Gum.—The residue, after percolation with ether alcohol, yielded 18 per cent. of gum to warm water, and was found to differ from gum arabic by being miscible with neutral plumbic acetate solution and a solution of borax. On inci-

Erythroxylaceæ.

neration it left a residue of 1·2 per cent. of a white ash, principally calcium carbonate.

Varieties of Gamboge:—

S. India and Ceylon from *Garcinia Morella*, var. *sessiliflora*.

Coorg „ *Garcinia* species.

S. India and Ceylon „ *Garcinia pictoria*.

Travancore „ *Garcinia Travancorica*.

Sylhet „ *Garcinia elliptica*.

The gamboge produced from these varieties is seldom met with in European markets.

Adulteration.—Pipe gamboge is rarely submitted to adulteration, but cake or lump gamboge is mixed with all manner of substances, the principal being ground rice.

Tests.—Good Gamboge should be imperfectly soluble in a mixture of ether and alcohol, and the insoluble residue left should be readily soluble in water; if any insoluble portion remains, boil it with water and allow it to cool, then add a drop or two of a solution of iodine in potassium iodide; if a dark blue colour is produced it indicates starch. Examine a portion of the insoluble residue under the microscope, when the peculiar character of rice starch is easily recognisable.

Therapeutics.—A drastic purgative; in large doses it is poisonous.

Official Preparation.—*Pilula Cambogiæ Composita*.

ERYTHROXYLACEÆ.

No. 36. Cocæ Folia. *Coca Leaves. Coca or Ipadu.*

Synonym:—Cuca.

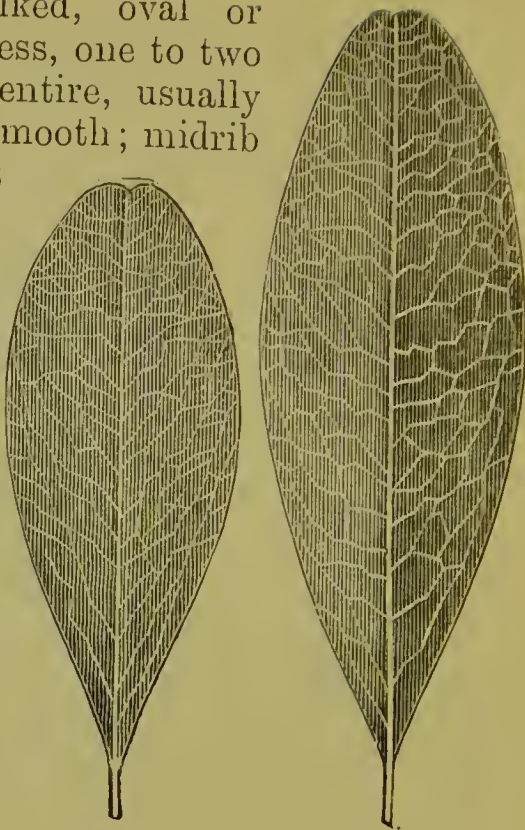
The dried leaves of *Erythroxylon Coca*.

The Ypadu or Coca plant is a small shrub, with numerous reddish-brown branches: with small yellowish white flowers, and a brilliant scarlet drupaceous fruit. Growing at an altitude of 6000 feet.

Habitat.—Indigenous to Bolivia and Peru, on the eastern slopes of the Andes.

Erythroxylaceæ.

Characters. — Shortly stalked, oval or lanceolate, of varying thickness, one to two inches or more in length, entire, usually blunt and emarginate, quite smooth; midrib prominent, with numerous faint freely anastomosing lateral veins, and on each side of the midrib a curved line extends from base to apex; green above, somewhat paler beneath. In commercial specimens the leaves are more or less broken, and frequently yellowish-green, yellowish-brown, or brown, and in rare cases the curved lines are indistinguishable. Odour faintly tea-like, especially when bruised; taste somewhat bitter and aromatic.



COCA LEAVES.

Chemical Composition.—The leaves afford two alkaloids, one of which is volatile, and a peculiar variety of tannic acid, which strikes a dark green colour with ferric salts.

Preparation.—Cocaine, or Erythroxyline, $C_{17}H_{21}NO_4$. Coca leaves are thoroughly exhausted with warm water, and the solution concentrated; tannin and colouring matter precipitated with basic plumbic acetate, filtered and excess of sodium carbonate added, and the solution agitated with ether, removing the ethereal superstratum and evaporating it carefully. It is then purified by re-solution in dilute sulphuric acid, and filtering through purified animal charcoal, precipitating with sodium carbonate, agitating with ether, decanting the ethereal layer, and allowing to crystallise by spontaneous evaporation. It occurs in colourless prisms with an alkaline reaction and bitter taste, and is with difficulty soluble in water (about 1 in 700), but readily in alcohol or ether.

Cocaine Hydrochlorate, $C_{17}H_{21}NO_4HCl$, is prepared by neutralising the alkaloid with hydrochloric acid, and

Vitaceæ or Ampelideæ.

crystallising from alcohol. It is easily soluble in water and alcohol. It should dissolve with frothing in concentrated sulphuric acid without change of colour (P. J. (3) xvi. p. 501). Boiled with strong hydrochloric acid it decomposes into benzoic acid, methyl alcohol, and ecgonine. This reaction proves cocaine to be benzoyl-methyl-ecgonine, $C_{17}H_{21}NO_4 + 2H_2O = CH_3OH + C_6H_5COOH + C_9H_{15}NO_3$. Ecgonine is precipitated from the solution, after neutralising, by adding twice its volume of absolute alcohol.

Purification of Cocaine Hydrochlorate.—This salt of Cocaine, which is frequently contaminated with amorphous alkaloid, may be freed from it and other impurities by dissolving the salt in the smallest possible quantity of absolute alcohol, 795, and then adding six times its volume of absolute anhydrous ether, (Williams). The pure salt readily crystallises out, leaving impurities in solution; over 99 per cent. of the pure salt will separate.

Cocaine can be separated from hygrine by adding to the solutions of their hydrochlorates, solution of platinum chloride; the hygrine double salt is insoluble, and cocaine remains in solution.

Hygrine was isolated by Lossen, by distillation with an alkaline earth. It occurs as a pale yellow oil, with a pungent burning taste, and strong alkaline reaction, and has an odour not unlike that of trimethylamine.

Preparations.—Extractum Cocæ Liquidum; Cocainæ Hydrochloras.

VITACEÆ or AMPELIDEÆ.**No. 37. Uvæ Passæ. Raisins.**

The ripe fruit of the *Vitis vinifera*, dried by exposure to the sun's heat, or partially by sun's heat, and by artificial heat.

Habitat.—Indigenous to Western Asia, largely cultivated in Southern Europe.

Description.—Ripe fruit. In the immature condition it is two-celled, but after development the septum becomes

Zygophyllaceæ.

obliterated, the fruit is globular or oblong in form, and generally covered with a fine coating of wax, the so-called "bloom."

The Dried Fruit is generally shrivelled and flattened orbicular, and of a brownish-red colour, smooth, and free from sugary or saline incrustation; agreeably fragrant, with a soft, very sweet pulp. Raisins on keeping become darker, opaque, and encrusted with crystallising matter (sugar and acid tartrate of potassium). Valencia raisins are the variety intended to be used in pharmacopœial preparations.

Collection.—When the fruit is ripe the stalk is generally cut half through, or twisted, and the grapes allowed to hang for some time, when they gradually wither and shrink up. They do not fall off, the pedicels being nonarticulated to the branches. Frequently they are dipped two or three times in weak alkali, to remove the waxy covering, and afterwards dried by artificial heat.

Chemical Composition.—The pulp of the fruit contains acid tartrate of potassium, grape sugar, pectin, gum, and a little malic acid. The skin contains colouring matter, and a small quantity of tannin. The seeds contain 4 to 6 per cent. of tannin, and 10 to 20 per cent. of a bland fatty oil. Grape seed oil is of a light yellow colour, inodorous, and congeals at 3·2° F. It is a drying oil, and is composed of the glycerides of stearic, palmitic, and erucic acids.

Official Preparations.—Tinctura Cardamomi Composita; Tinctura Sennæ.

ZYGOPHYLLACEÆ.**No. 38. Guaiaci Lignum. *Guaiacum* Wood.**

Synonym:—*Lignum Vita*.

The heart-wood of *Guaiacum officinale*, and of *Guaiacum sanctum*.

Habitat.—Indigenous to the West Indian Islands and the northern coast of South America. Imported principally from the port of Hayti.

Description.—The wood as imported is generally denuded of its bark, and in the larger pieces the sapwood is found

Zygophyllaceæ.

as a very thin layer. The heart-wood is of a brown or brownish-green colour, changing to a lighter green on exposure : throughout its mass is found a number of zones, differing in the degree of their colour, which give to a section of the wood the appearance of a number of rings. The pores are filled with a brown-coloured resin. The specific gravity of this wood is very high, ranging from 1·2 to 1·3. The fibro-vascular bundles of the wood are arranged in a peculiar interlacing and zigzag manner, so that it has no cleavage.

On account of its extreme hardness and durability it is largely used in ship carpentry, and for supports to the propellers of steamships. That which is met with in pharmacy is generally in raspings or shavings. When touched with nitric acid they assume a transient blue-green colour. Other oxidising agents, such as chlorinated lime solution, will produce the same effect.

For use in pharmacy, it should be deprived of its sapwood.

Chemical Composition.—The heartwood contains the resin, 20 to 25 per cent., and, according to Fremy, 20 per cent. of cellulose and 30 per cent. of vasculose ; the wood yields to boiling water about 4 per cent. of its weight.

Official Preparation.—Decoctum Sarsæ Compositum.

No. 39. Guaiaci Resina. *Guaiacum Resin.*

The resin obtained from the stem of *Guaiacum officinale*, or of *Guaiacum sanctum*, by natural exudation, by incision or by heat.

Production.—In the islands of St. Domingo and Gonave the resin is collected as a natural exudation, or by a system of puncturing or incising the bark. This constitutes the guaiacum resin in tears. By far the larger proportion is prepared from the old logs, which are supported on iron uprights, and pierced or grooved lengthwise on the side, or a large hole is made in the middle, and then both ends are set on fire. After a short time the resin melts and exudes as a dark thick liquid ; it is allowed to run into small square boxes, which are covered inside with a piece of coarse cloth.

Zygophyllaceæ.

The bulk of the resin is supplied by the *Guaiacum officinale*, because it contains a larger proportion.

Characters.—In roundish or somewhat oval tears, or more commonly in large masses containing fragments of bark, wood, and other impurities; brownish or greenish-brown externally, and, when the surface has been rubbed and exposed to air and light, covered with a green powder. It is brittle, breaking with a clean glassy fracture; thin splinters are transparent and greenish-brown; powder greyish, but by exposure becoming green. Odour somewhat balsamic; and when chewed leaving an acrid sensation in the throat. A solution in rectified spirit strikes a clear blue colour when applied to the inner surface of a paring of raw potato. It has a specific gravity of 1.2. It is soluble in liquor potassæ, alcohol, carbon bi-sulphide, turpentine, and benzol. When dissolved in caustic potash solution, it should yield little or no insoluble residue. Occasionally, as much as 15 to 20 per cent. of wood is found in samples of guaiacum.

Chemical Composition.—This resin is of complex composition, containing a number of acids and two neutral bodies:—Guaiaconic, guaiaretic, and guaiacic acids, guaiac beta resin, and guaiac yellow, with small quantities of gum.

Separation of its Constituents.—The resin is boiled for some time with an equal weight of milk of lime, and filtered; the filtrate is now acidulated with hydrochloric acid, when guaiacic acid and guaiac yellow are precipitated. The residue is treated with boiling alcohol until it passes colourless, after which the alcohol is recovered, and the mass treated with a warm solution of sodium hydroxide (sp. gr. 1.3), and filtered while hot; from the filtrate the sodium salt of guaiaretic acid crystallises on cooling; this, when treated with dilute mineral acids, precipitates guaiaretic acid; the mother liquor contains the guaiaconic acid and beta resin, this is neutralised with hydrochloric acid and evaporated to dryness, and exhausted with alcohol which removes the guaiaconic acid and beta resin. This alcoholic solution is evaporated to dryness and treated

Zygophyllaceæ.

with ether, which removes the guaiaconic acid, leaving the beta resin.

Guaiaretic Acid, $C_{20}H_{26}O_4$, crystallises from its solution in scales, soluble in chloroform, ether, benzine, carbon bisulphide, sparingly soluble in solution of ammonia or water; it possesses an agreeable odour slightly resembling vanilla; it melts at $78^{\circ}C.$, and sublimes unchanged. Oxidising agents do not colour it.

Guaiacic Acid, $C_{12}H_{16}O_6$, crystallises in fine white needles, and is found only in minute quantities. It is soluble in water, alcohol, and ether.

Guaiaconic Acid, $C_{38}H_{40}O_{10}$, is an amorphous substance of a light brown colour, and is the principal constituent of the resin; it fuses at $100^{\circ}C.$, does not affect litmus, but decomposes an alkaline carbonate. It is insoluble in benzine, water, and carbon bisulphide; readily soluble in ether, chloroform, and alcohol, and gives a fugacious blue colour with oxidising agents.

Guaiac Yellow separates from alcohol in pale yellow octahedral crystals, having an intensely bitter taste; it dissolves in sodium hydrate solution forming a deep yellow liquid. When the crystals are treated with strong sulphuric acid they dissolve, forming a fine blue liquid.

Guaiac Beta Resin is a reddish-brown powder, soluble in alcohol, from which it is precipitated by ether. It seems to be closely allied to guaiaconic acid. When guaiacum resin is submitted to dry distillation, a number of products pass over, including guaiacol, $C_6H_4(OH)(OCH_3)$, guaiacene, C_5H_8O , pyroguaiacin, $C_{19}H_{22}O_3$, and creosol, $C_8H_{10}O_2$. The resin, on incineration, leaves nearly 1 per cent. of ash.

As this resin is frequently used to test for ozone, only the natural and not the purified should be used.

Adulteration.—Frequently, from careless manipulation, the resin contains a considerable quantity of wood, and colophony resin has been found in it. They can be detected by their different action towards solvents.

Tests.—When macerated in petroleum ether, it should not lose more than 2 to 5 per cent. of its weight. Its

Rutaceæ.

alcoholic solution is turned blue by alcoholic ferric chloride, and is precipitated by alcoholic plumbic acetate, and with caustic potash gives a precipitate readily soluble in excess.

Colophony and *Dammar Resin* yield nearly 90 per cent. to petroleum ether.

Peruvian Guaiacum yields 40 per cent. to the same solvent. Gently heated it ought not to evolve a terebinthinate odour.

Official Preparations. — *Mistura Guaiaci Composita*; *Pilula Hydrargyri Subchloridi Composita*; *Tinctura Guaiaci Ammoniata*.

RUTACEÆ.**No. 40. Ruta. Rue.**

(*Not official.*)

The fresh herb of *Ruta graveolens*.

Habitat.—Found growing wild in Southern Europe.

Description.—The Rue plant is a small evergreen herbaceous undershrub, with delicate green bipinnate leaves, supported on long petioles, varying from 1 to 4 inches in length, the lower leaves being the largest, triangular ovate in form, slightly coriaceous in texture, smooth and dotted with numerous oil vesicles, with the margin slightly crenate. The flowers are pale yellow in colour, in terminal corymbs; fruit, a 4 or 5 locular capsule with a number of vivid dark coloured seeds. The whole plant possesses a strong persistent balsamic odour, and bitter acrid taste.

Chemical Composition.—The leaves and fruits, when distilled, yield a considerable amount of volatile oil; they also contain a peculiar principle, rutin or rutinic acid, which splits up when treated with dilute sulphuric acid or zinc chloride into rutin sugar, and quercetin, and on account of this reaction has been said to be identical with quercetin, but the unfermentable rutin sugar does not agree with isodulcite, and has the formula $C_{12}H_{18}O_9$. As much as 44 per cent. of quercetin has been obtained (Foerster). It is most difficult to isolate pure rutin, as it is always accom-

Nº 41.



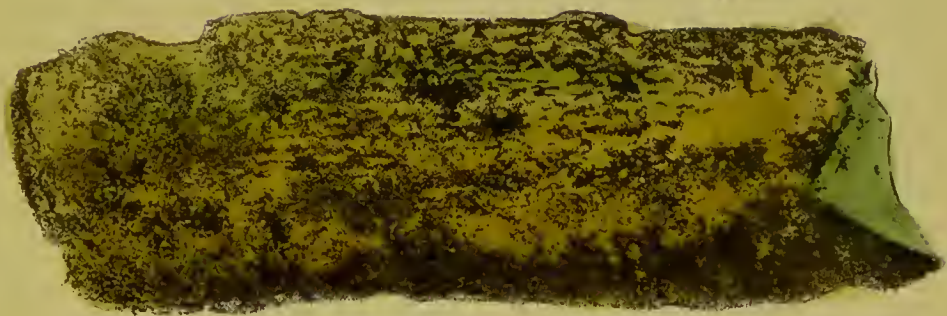
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2



3



Nº 42



Nº 64.

Hilum



Nº 69.



Nº 64.

Peramen

Chalaza.

Nº 68.



Acutifolia obovata.



argel.

Rutaceæ.

panied by a body resembling coumarin and a resin; it is precipitated from its alcoholic solution by ether.

The volatile oil is obtained from the fresh cut plant by steam distillation; it is best to distil the plant when in fruit, as a much larger yield is obtained, usually 2·5 per cent. When recently prepared the oil is almost colourless or only a pale greenish-yellow, neutral to litmus, with a bitter and pungent taste. It is soluble in an equal volume of absolute alcohol. When agitated with a solution of acid sodium sulphite a crystalline compound separates, and when oxidised with nitric acid it yields a mixture of acids of the higher homologous alcohols. The chief constituent of this oil is methyl-nonylketone, $\text{CH}_3\text{COC}_9\text{H}_{19}$, and a hydrocarbon $\text{C}_{10}\text{H}_{16}$.

Therapeutics.—Stimulant, Anti-spasmodic, and Emmenagogue.

No. 41. Buchu Folia. *Buchu or Bucco Leaves.*

The dried leaves of 1 *Barosma betulina*, 2 *Barosma crenulata*, and 3 *Barosma serratifolia*.

Habitat.—All three sources are shrubby plants, growing to a height of two or three feet, indigenous to South Africa, particularly to the district of Cape Colony.

Characters.—1. *Barosma betulina*. The leaves vary from $\frac{1}{2}$ to $\frac{3}{4}$ inch in length, cuneate or rhomboid-obovate in outline, generally obtuse with recurved apex, the margin is serrate-dentate, base entire, texture coriaceous.

2. *Barosma crenulata*. The leaves vary from $\frac{3}{4}$ to 1 inch in length, oval-oblong, or rhomboid-oval; apex obtuse, margin serrate-crenate, base prolonged into a distinct petiole.

3. *Barosma serratifolia*. The leaves are from 1 to $1\frac{1}{2}$ inch long, linear lanceolate, tapering at both ends, actual apex truncate, midrib prominent, margin sharply and closely serrate.

The first two varieties occur usually mixed, and are more closely allied in their characters; the leaves of the last species materially differ in shape and texture, and commercially are known as long buchu. At the base of each crenature or

Rutaceæ.

serrature there is always a minute oil gland. In colour, the leaves are of a dull green, paler on the under surface, and throughout the mass of the leaves there are numerous oil glands or cells. Situated between the epidermis and mesophyll are a layer of cells, which, when immersed in water, become distended, and finally yield a large amount of mucilage, leaving only a bare outline of the cell wall. This character is distinctive of buchu leaves. The leaves when chewed have an aromatic and slightly bitter taste, and when warmed emit a strong odour somewhat resembling peppermint.

Composition.—Buchu leaves yield on distillation with water from .5 to 1.56 per cent. of a volatile oil; they also contain a body closely allied to rutin, resin, gum, and albuminous matter. The leaves, on incineration, leave from 4.3 to 5.7 per cent of ash.

The substance called diosmin, isolated by Landerer, has not been found in more recent investigations of this drug.

The volatile oil of buchu, when submitted to prolonged cold, deposits crystals of a stearoptene, which are easily separated, and the residual fluid portion removed.

Diosphenol or Barosma Camphor, $C_{14}H_{22}O_3$. This is the solid stearoptene which can be separated by cold, but it is best extracted by a process devised by Fluckiger. The buchu oil is agitated with an equal volume of solution of sodium hydrate, sp. gr. 1.14. It is then allowed to stand, when it separates into two layers. The heavier layer is removed and washed with ether, to remove any traces of the oil dissolved in the solution, after which it is neutralised by sulphuric acid, or, better, carbonic acid, when an oily layer separates. This is removed and dissolved in ether alcohol, and allowed to crystallise. Buchu oil yields 20 per cent. of diosphenol, which melts at $181.4^{\circ}F.$, and boils at $451.4^{\circ}F.$ It sublimes unchanged, and is readily soluble in alcohol, and in solutions of the alkali hydrates. It possesses a strong odour of peppermint, and with ferric chloride gives a black green colour.

The portion of the oil unaffected by sodium hydrate is an oxygenated compound, having the formula $C_{10}H_{18}O$, and is supposed to be a compound ether.

Rutaceæ.

Substitutes.—Buchu leaves as imported are mixed with a large number of the capsular fruits and flowers of the same plant. The leaves of *Empleurum serrulatum* are occasionally found. They are much longer than either of the buchu, they possess a similar structure to buchu leaves, but are distinguished by their extreme length and glandless acute apex, and by their want of aroma. After keeping for some time they acquire a yellow colour.

The leaves of *Barosma Eckloniana* are sometimes met with. They are about one inch long, rounded at the base, and strongly crenate.

Therapeutics.—A diuretic and diaphoretic, used chiefly for its action on the urinary organs.

Official Preparations.—*Infusum Buchu*, *Tinctura Buchu*.

No. 42. Cuspariæ vel Angusturæ Cortex. *Cusparia or Angustura Bark.*

The bark of *Galipea Cusparia*.

Habitat.—This tree grows on the mountains adjoining the watershed of the Orinoko.

Imported by way of Trinidad.

Characters.—The bark occurs in flattish or channelled pieces, from 3 to 6 inches in length. It is of a yellowish-brown colour internally, externally the epidermis is frequently coated with a greyish, scurfy, corky layer, which is easily removed by scraping with the finger nail. The inner edge is often obliquely cut, so as to present a bevelled appearance; the inner surface is often lamellar and has occasionally thin strips of wood attached. Fracture smooth, slightly granular, and exhibits a large number of minute striæ of glistening crystals of calcium oxalate, best noticed with a good lens. Taste bitter and aromatic, and the bark when bruised has a disagreeable odour. More recently this bark has occurred in much longer pieces, somewhat quilled.

Composition.—The bark contains several alkaloids, a little resin, volatile oil, and wax.

Volatile Oil.—This oil was obtained to the extent of .75 per cent., boiling at 511° F., and is probably a mixture of an oxygenated body and a hydrocarbon.

Rutaceæ.

The Alkaloids.—These principles, which exist mostly in the free state, are isolated by direct percolation with ether, when nearly 1 per cent. of total alkaloids is obtained.

Cusparine, $C_{19}H_{17}NO_3$. After washing the ethereal extract with weak caustic potash solution, the addition of dilute sulphuric acid gives a yellow coloured precipitate of impure cusparine sulphate, which is purified by recrystallisation from boiling alcohol. Cusparine is decomposed by boiling with caustic potash into a new alkaloid and an acid.

Galipeine, $C_{20}H_{21}NO_3$. This alkaloid can be extracted from the mother liquor after precipitation of the sulphate of cusparine by agitating with petroleum ether, from which it crystallises in colourless needles. Its salts are more soluble than those of cusparine.

A third alkaloid has been extracted, which melts at 180° F., the salts of which have a blue fluorescence (Koerner and Bœhringer).

Adulterations.—Cusparia Bark early in the century was sometimes sophisticated with the so-called false angustura bark derived from *Strychnos Nux Vomica*, but it is never found in commerce now. *Strychnos Nux Vomica* Bark is more irregular in form, and paler in transverse section. Its fracture is smooth, and there is an absence of white striæ. Externally it is covered with a fine grey epidermis, with occasional brown-coloured patches of cork and white warts; internally it does not present a laminated surface or structure like that of cusparia. Taste intensely bitter, but not aromatic. An infusion or decoction of this bark is coloured a bright red on the addition of nitric acid, whereas an infusion of cusparia is not affected. This is much more reliable than the method of touching the bark with nitric acid.

The bark of *Esenbeckia febrifuga* (Brazilian Angustura bark) has been substituted for cusparia, likewise guaiacum and copalchi bark, but these are not easily mistaken for cusparia.

Therapeutics.—An aromatic tonic and febrifuge.

Official Preparation.—Infusum cuspariæ.

No. 43. Jaborandi. *Jaborandi or Pilocarpus.*

The dried leaflets of *Pilocarpus pennatifolius*.

Habitat.—Pernambuco.

Rutaceæ.

Characters.—Leaves are imparipinnate, and vary from 4 to 10 shortstalked leaflets, usually 4 to 6 inches in length, and the terminal one generally with a longer stalk, oval or ovate oblong, obtuse, and nearly always emarginate, revolute, and entire at the margins. The upper surface shining and dull green, under surface paler, slightly hairy, and with a very prominent midrib, veins anastomosing, and reaching to near the margins. Texture coriaceous. The whole mass of the lamina is marked irregularly with numerous pellucid dots or glands. Odour, on bruising, somewhat aromatic, but the entire leaves are almost inodorous, taste aromatic, and slightly bitter, but subsequently warm and pungent, increasing the flow of saliva.

Composition. — The leaves yield a volatile oil, and a non-volatile alkaloid, pilocarpine or jaborandine. Volatile



JABORANDI LEAF.

Rutaceæ.

oil is obtained to the extent of .5 per cent., and is composed of three hydrocarbons—one, pilocarpene, being the principal constituent. Another alkaloid, jaborine, has been obtained from the leaves; it does not form crystallisable salts; it is probably a derivative of pilocarpine.

Pilocarpine or *Jaborandine*, $C_{11}H_{16}N_2O_2$. The proportion of this alkaloid varies in different samples of leaves, the maximum yield being nearly 1 per cent. Several methods may be adopted in assaying this drug, based on the solubility of the alkaloid in weak ammonia solution, or in acidulated water. The alcoholic extract is prepared by dissolving in water, rendering alkaline by the addition of weak solution of sodium hydrate, agitating with chloroform, and removing the chloroformic solution, and agitating the solution with 5 per cent. sulphuric acid once or twice, then rendering the solution alkaline by the addition of sodium bicarbonate, then again agitating with chloroform, removing the chloroform, and evaporating by the heat of a water bath, when the alkaloid is left as an amorphous residue.

When pilocarpine is boiled with strong hydrochloric acid it yields pilocarpidine, $C_{10}H_{14}N_2O_2$. If rapidly heated to $175^\circ C$ it breaks up into jaborine, jaboric acid, and pilocarpidine.

Synthesis of Pilocarpine.—This is one of the very few alkaloids which have been prepared artificially. Hardy and Calmels, beginning with β pyridine-lactic acid, treated it with phosphorus tribromide in carbon bisulphide, the product was β pyridine α bromo-propionic acid; this was precipitated as a gold salt, and decomposed with hydrogen sulphide. The syrupy product was dissolved in trimethylamine and heated in sealed tubes, thus yielding pilocarpidine, which was removed with ether. To the pilocarpidine, methyl iodide was added, and the product oxidised with silver permanganate, when pilocarpine was found in the solution.

Pilocarpinæ Nitras, $C_{11}H_{16}N_2O_2HNO_3$. This and the other salts of pilocarpine are prepared by neutralising the corresponding dilute acid with the amorphous alkaloids. The salts are crystallised over sulphuric acid, and purified by recrystallising from boiling alcohol. Nitrate of pilocarpine

Simarubaceæ.

occurs in minute acicular crystals, soluble in 8 or 9 parts of water at 60° F., freely soluble in boiling alcohol, but the bulk is deposited on cooling. Dissolved in strong sulphuric acid it forms a clear yellow solution, which on the addition of a trace of potassium bichromate or permanganate, assumes an emerald green colour. Fused with caustic potash it is decomposed, evolving trimethylamine.

Adulteration.—Jaborandi leaves are occasionally mixed with the leaves of other species of *Pilocarpus*, and recently the leaves of a kind of *Piper* have been offered in the London market as Jaborandi. They are thinner, and although finely glandular, do not present the pellucid punctate appearance of true Jaborandi.

Therapeutics.—Diuretic, diaphoretic, and expectorant.

Used in the preparation of *Extractum Jaborandi*; *Infusum Jaborandi*; *Tinctura Jaborandi*; *Pilocarpinæ Nitræ*.

SIMARUBACEÆ.**No. 44. Quassiæ Lignum.** *Quassia Wood. Bitter Wood.*

The chips, raspings, or shavings of the wood of *Picræna excelsa*.

Habitat.—Indigenous to the islands of Jamaica, St. Vincent, and Antigua, where the tree attains a height of 70 feet.

Characters.—As imported, Jamaica quassia, or bitter wood, is found in billets, varying in length and size from 2½ to 7 feet in length, from three to 20 inches thick, and occasionally covered with a dark grey bark. The wood is dense, tough, porous, and of a light yellowish-white colour, and of medium hardness. It is inodorous, with an intensely and purely bitter taste. As used in pharmacies it is found in raspings, chips, or shavings. The wood is frequently turned in the form of cups or tumblers, which are known as Bitter Cups. A watery infusion shows a slight fluorescence, especially if a little caustic lime be added.

Composition.—Quassia wood contains a neutral principle, quassiin, to which it owes its intense bitterness, and a

Simarubaceæ.

little resin. Quassia is one of the few bitters which, from containing no tannin, are prescribed with ferric salts.

Quassiin, $C_{31}H_{44}O_{10}$. This neutral principle is best prepared by exhausting the wood with water containing a small quantity of potassium carbonate, and then evaporating to an extract, which is allowed to stand in contact with 90 per cent. of alcohol for twenty-four hours; the alcoholic solution, decanted and acidulated with sulphuric acid, is filtered, and the sulphuric acid precipitated by the addition of lime. Through the clear solution is passed a current of carbonic anhydride, to remove any trace of lime, after which the liquid is decanted, and the alcohol recovered by distillation, when an amorphous residue of quassiin is left. Crystallised quassiin can be obtained by stopping the distillation when only a small quantity of alcohol remains, then filtering and allowing the liquid to slowly evaporate.

Quassia wood yields .08 per cent. of crude quassiin or .015 per cent. of crystallised quassiin.

Quassiin crystallises in slender rectangular prisms, or iridescent silky needles, has an intensely bitter taste, is readily soluble in chloroform, sparingly so in alcohol, and soluble in about 300 parts of boiling water. It is non-glucosidal, but by prolonged treatment with dilute sulphuric acid it is decomposed, yielding quasside, $C_{31}H_{38}O_9$. It is precipitated from its solution by tannic acid.

Substitutes.—Surinam Quassia, which frequently finds its way to this country, is obtained from *Quassia amara*, a tree indigenous to Surinam. The billets are much smaller, rarely exceeding 4 inches in diameter, but principally in thinner pieces. The wood is denser, and of a more compact texture.

Therapeutics.—A bitter stomachic and tonic.

Used in the preparation of *Extractum Quassiæ*; *Infusum Quassiæ*; and *Tinctura Quassiæ*.

No. 45. *Simarubæ Cortex.* *Simaruba Bark.*

(*Not official.*)

The bark of the root of the *Simaruba officinalis* (*Simaruba amara*) and *Simaruba medicinalis*.

Rhamnaceæ.

Habitat.—The first species is found as a large tree in Venezuela and Northern Brazil. The second species is indigenous to the West Indian Islands and Central America.

Characters.—Simaruba bark occurs in quilled or curved pieces several feet in length. When the suberous layer is present it has an uneven rough appearance, and is externally of a brownish colour. As usually met with, the bark is of a yellowish-grey colour, tough, fibrous, and breaks with difficulty, and the inner surface is slightly striate.

Composition.—Simaruba bark contains a bitter principle supposed to be identical with quassiin; it also contains a little resin, volatile oil, and calcium salts of organic acids.

Nearly all the plants belonging to Simarubaceæ possess a bitter principle.

Therapeutics.—Bitter tonic.

CALYCIFLORÆ.

RHAMNACEÆ.

No. 46. Rhamni Fructus. *Buckthorn Berries.*

(*Not official.*)

The dried ripe fruits of *Rhamnus catharticus*.

Habitat.—Indigenous to this country, and throughout Europe generally.

Characters.—The fruit in the fresh condition is a black, glossy, spherical, four-celled drupe, about the size of a small pea, with the remains of the calyx attached to its base. Each cell contains a hard, dark-coloured, grooved seed. The unripe fruit is green, becoming black on ripening. The dried fruit is deeply wrinkled, due to the contraction of the succulent sarcocarp.

The endocarps have a sharp angle on the inner face, and have therefore a triangular transverse section.

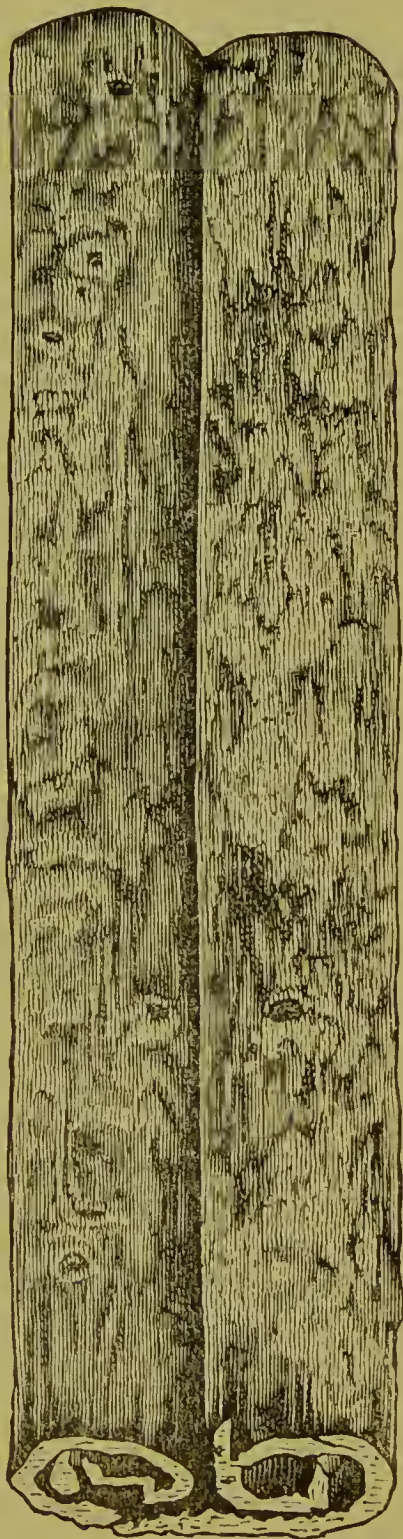
Rhamnaceæ.

Habitat.—A shrubby plant, growing throughout Europe in moist hilly woods or damp situations.

Characters.—Alder Buckthorn bark occurs in small quills from one twenty-fifth to one twelfth of an inch in thickness, externally of a greyish-brown, or, if collected from the younger branches, a black-brown corky layer marked with numerous transverse small whitish lenticels or suberous warts; internally of a brownish-yellow or dark orange-yellow. Smooth, breaks with a short fibrous fracture, which, on examination, shows a purplish coloured layer externally, a greenish middle layer, and yellow bast fibre internally. When fresh it has a disagreeable odour and taste, but becomes odourless on drying, with a slightly bitter and sweetish pleasant taste. When moistened on the inner surface, with a drop of potassium hydrate solution, it acquires a dark red colour.

Composition.—This bark contains frangulin, resin, tannin, and an amorphous bitter principle.

Frangulin or rhamnoxanthin, $C_{48}H_{26}O_{29}$, is most readily extracted from the bark by digesting in pure carbon disulphide for twenty-four hours, and then carefully evaporating to dryness, finally recrystallising from ethyl alcohol. It occurs in minute



FRANGULA BARK.

Rhamnaceæ.

silky crystals of a pale lemon-yellow colour, tasteless and odourless; it sublimes unchanged. On hydrolysis it yields glucose and frangulic acid, $C_{16}H_{12}O_5$. When the bark is boiled for some time with dilute sulphuric acid, the decoction contains emodin, $C_{15}H_{10}O_5$. The freshly collected bark is non-purgative, but it becomes so on keeping, due to some as yet unknown physico-chemical change taking place. The tannin gives a brownish-green colour with ferric salts. The bitter principle appears to be purgative. Traces of hydrocyanic acid have been found in the bark.

Therapeutics.—Mild purgative, useful in chronic constipation.

Official Preparations.—Extractum Rhamni Frangulæ, and Extractum Rhamni Frangulæ Liquidum.

No. 48. Rhamni Purshiani Cortex. *Cascara Sagrada,*
Sacred Bark.

The dried bark of Rhamnus Purshianus (Frangula Purshiana.)

Habitat.—Indigenous to the west coast of North America, extending southwards to California.

The bark is largely collected in California, where most of the small quill bark is prepared, frequently by a process similar to shaving. Large quills of considerable thickness are prepared in Oregon and shipped from Portland. It is advisable to store this bark for two or three years before use.

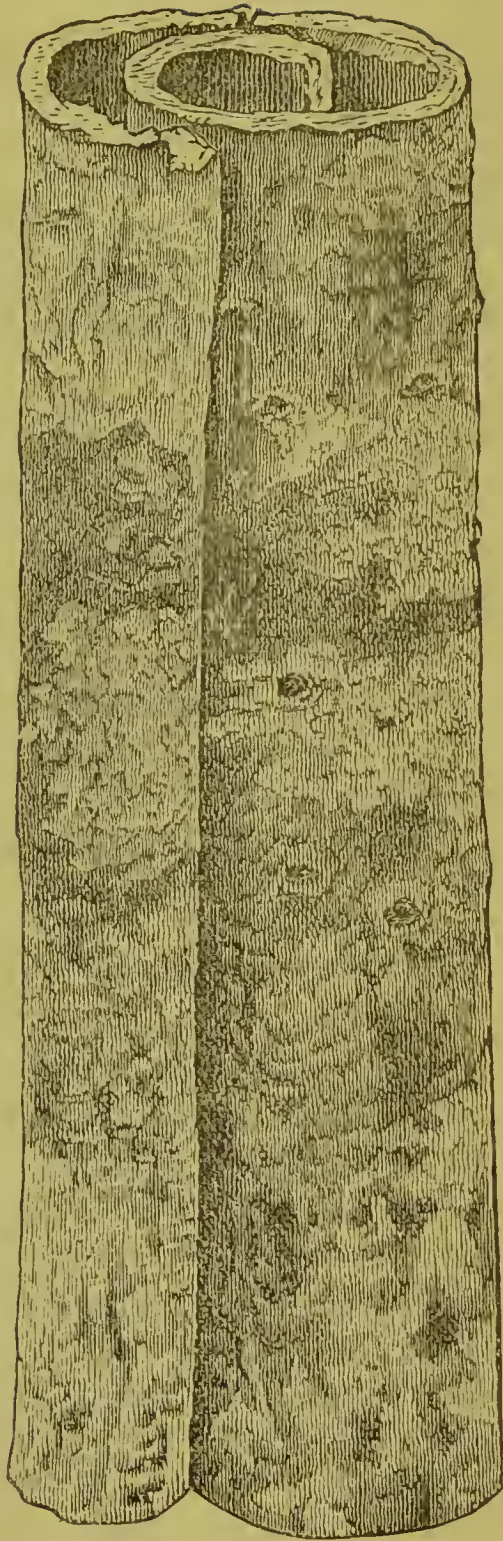
Characters.—In quills or in curved pieces of varying lengths and sizes, the bark itself being from about one twenty-fifth to one-eighth of an inch thick, smooth or nearly so externally, covered with a greyish-white layer, which usually is easily removed, and is frequently marked with spots or patches of adherent lichens. Beneath the surface it is violet-brown, reddish-brown, or brownish, and internally reddish-brown, or yellowish-brown, sometimes black, the colour depending on the manner of drying, and nearly smooth, although somewhat striated longitudinally. Frac-

Rhamnaceæ.

ture short, except internally, where it is slightly fibrous, more especially in the larger pieces. No marked odour; taste bitter. It is frequently imported in flattened packets, consisting of small pieces of the bark compressed into a more or less compact mass.

Composition.—*Rhamnus Purshianus* bark contains three resins amounting to 10 per cent., by weight, of the bark, a neutral crystalline principle, tannin, malic and oxalic acids, and a minute quantity of volatile oil having the characteristic odour of the bark. The brown resin has a strong persistent bitter taste, and is found in the inner and middle layers of the bark; it is sparingly soluble in water, readily in alcohol, and dissolves in solutions of the alkaline hydrates, forming a dark purple-coloured solution.

The light yellow resin is a neutral principle insoluble in water, soluble in alcohol and chloroform; its solution in potassium hydrate is colourless, sulphuric acid colours it a bright red. The red resin is readily soluble in ether, alcohol, and chloroform, insoluble in water; its solution in potassium hydrate is a dark brown. It mainly resides in the suberous layer of the bark. The crystalline principle is



SACRED BARK.

Anacardiaceæ.

very sparingly soluble in alcohol, more freely in benzol, but not in ether or chloroform.—*Prescott.*

Substitutes.—The bark of *Rhamnus Californica*, and *R. Caroliniana* are used in some districts of North America in place of the *Cascara sagrada*.

Official Preparations.—*Extractum Cascaræ Sagradæ*, and *Extractum Cascaræ Sagradæ Liquidum*.

ANACARDIACEÆ.**No. 49. Mastiche. *Mastich.***

A concrete resinous exudation obtained by making slight incisions in the bark of the stem and large branches of *Pistacia Lentiscus*, the *Lentisk*.

Habitat.—Indigenous to the shores of the Mediterranean; mainly obtained from the island of Scio, and others of the Grecian Archipelago.

Secretion.—The resin is found principally in the bast layer of the bark of the stem and branches; it is contained in elongated resin ducts, surrounded by a number of small cells which secrete the resin.

Collection.—To obtain the resin, which is contained in the bark only, and not in the wood, slight vertical incisions are made in June and July. After exuding for a period of three weeks, the tears are carefully removed, and then dipped in sea-water, and finally dried by exposure to the air. A good tree yields about ten pounds of *mastich*.

Characters.—In rounded, irregular, oblong, or pear-shaped tears, of a pale yellow colour, and either opaque and dusty on their outer surface, or, far more frequently, having a glassy and transparent appearance; brittle and breaking with a vitreous, conchoidal, pale yellow fracture. Odour agreeable, somewhat balsamic and terebinthinate; taste mild and resinous. Becoming plastic when chewed; entirely soluble in ether. Sp. gr. 1.06 to 1.08 It is soluble in alcohol to the extent of 90 per cent., and this solution reddens tincture of litmus; entirely soluble in oil of turpentine, chloroform, or ether.

Anacardiaceæ.

Composition.—Mastich contains a minute quantity of a volatile oil, and two resins.

Masticic acid or alpha-resin, $C_{20}H_{32}O_3$, occurs to the extent of 90 per cent., and is freely soluble in alcohol, ether, chloroform, and oil of turpentine. Masticin, or beta-resin, $C_{20}H_{31}O_2$, is insoluble in alcohol, but readily soluble in ether.

The volatile oil is usually only met with in minute quantities, but occasionally as much as 2·25 per cent. is found. It is a true terpene, $C_{10}H_{16}$, with a strong but agreeable odour.

Adulterations.—Sandarach is liable to be mistaken for mastich. It is the resinous exudation of *Callitris quadrivalvis* (Nat. Ord. Coniferæ), a tree found throughout the northern coasts of Africa, which yields a resin very similar in appearance to mastich, but the tears are more elongated, with a glassy fracture, transparent, of a pale yellow colour, and almost entirely soluble in alcohol. When masticated it is brittle and pulverulent, with a marked terebinthinate taste.

Acantho-mastich, an exudation of *Atractylis gummifera*, consists of a number of tears agglutinated together; the tears are about one to two inches in length. It is principally met with in Greece, but it is not an article of English commerce.

Bombay Mastich, probably derived from *P. Khinjuk*, is perfectly soluble in alcohol, and the solution is coloured brown with saturated solution of ferric chloride, which is not the case with true mastich.

Therapeutics.—The action is the same as that of the resin of turpentine; it is but little used. From the agreeable odour which it communicates to the breath, it is sometimes employed as a masticatory. Dissolved in chloroform or ether, it is often used for stopping carious teeth.

Burseraceæ or Amyridaceæ.

No. 50. Terebinthina Chia, vel Cyprica. *Chian or
Cyprian Turpentine.*

(Not official.)

An oleo-resin obtained by making incisions in the bark of *Pistacia Terebinthus*.

Habitat.—The Grecian Archipelago.

Collection.—The oleo-resin is contained in resin ducts similar to those secreting mastich. The bark is slightly incised, and the exudation goes on during the spring and summer. The resin is removed by scraping from time to time, and purified by melting and straining.

Characters.—The oleo-resin is a soft solid, becoming semi-fluid on the slightest application of heat, transparent, entirely soluble in alcohol, benzol, and glacial acetic acid. It has a pleasant but slight terebinthinate odour, and a taste resembling mastich, but not bitter.

Composition.—Chian turpentine yields on careful distillation 15 per cent. of a volatile oil, possessing the characteristic odour of the drug, and of Sp. gr. .869.

The residual resin is entirely soluble in strong alcohol, and is probably identical with the alpha-resin of mastich.

Adulteration.—The different resins left after the distillation of the various turpentines are sometimes substituted, also the dry clear resin obtained from Canada balsam; on warming they emit a strong terebinthinate odour.

Therapeutics.—Chian turpentine has been used in cases of uterine cancer for some time, but is of doubtful value in this disease.

BURSERACEÆ or AMYRIDACEÆ.

No. 51. Myrrha. *Myrrh.*

A gum-resinous exudation obtained from the stem of *Balsamodendron Myrrha*.

Burseraceæ or Amyridaceæ.

Habitat.—The Somali country, Eastern Africa, and South Western Arabia. It is usually shipped from Berbera or Aden to Bombay, and thence to this country.

Secretion.—Myrrh appears to be chiefly deposited in the layers of the bark, and a small proportion in the medulla.

Collection.—Myrrh is an exudation, partly natural, and partly obtained by making punctures in the bark. It first exudes as a thick oily substance, gradually acquiring a firmer consistency, of a yellowish-white appearance, ultimately becoming of a dark reddish colour. It is mainly collected by the Somalis, who besides obtaining it in their own country, cross over to Arabia, and pay tribute to the Fadhli tribe for the privilege of collecting it there.

At one time myrrh entered into commerce through Smyrna, and other ports of the Levant, and thus obtained the name Turkey myrrh.

Characters.—In roundish or irregularly formed tears, or in masses of agglutinated tears, varying very much in size; reddish-brown or reddish-yellow externally, dry, and more or less covered by a fine powder; brittle, the fractured surface irregular, somewhat translucent, rich brown, oily, and frequently marked with opaque whitish spaces or striæ. Odour agreeable, aromatic; taste aromatic, bitter, and acrid. When treated with strong alcohol it loses about one half its weight, and when triturated with water it yields a reddish-yellow emulsion. The alcoholic solution of the resin gives a violet-coloured solution when agitated with a drop of bromine, and is precipitated with alcoholic plumbic acetate, and forms a milky fluid on addition of solution of ammonia of Sp. gr. .880.

Composition.—Myrrh contains gum, resin, and volatile oil; a good sample yielded, on incineration, 4.2 per cent. of ash, principally calcium carbonate.

The gum is found in quantities varying from 45 to 75 per cent. Its solution is only partly precipitated with neutral plumbic acetate, 20 to 25 per cent. remaining in solution, showing that it is composed of two gums, one

Burseraceæ or Amyridaceæ.

being identical with gum acacia. The residue left after making tincture of Myrrh, is the gum, and is admirably suited for rendering labels adhesive.

The Volatile Oil can be obtained to the extent of $\frac{3}{4}$ per cent. by mixing myrrh with six times its weight of finely powdered pumice, and packing the mixture in a tube, to which is attached an efficient condenser, and then passing a current of steam through the tube. The aqueous distillate, after removal of the oil, is generally faintly acid in reaction, and readily reduces silver, mercury, and gold salts; this is usually ascribed to small quantities of formic acid. Oil of myrrh has a Sp. gr. of .988; but some samples obtained from old myrrh are slightly heavier than water; colour pale yellow, changing to reddish-brown, odour powerful but agreeable, consistency rather viscid; it is readily oxidised, and amongst the products formic acid is found. It is soluble in alcohol, ether, and carbon bisulphide, which latter solution, on addition of nitric acid or bromine, acquires, after a time, a blue or violet colour. It is an oxygenated oil, and is said to closely resemble thymol or carvol, $C_{10}H_{14}O$.

The Resin is readily extracted by alcohol, chloroform, or ether; it is nearly insoluble in petroleum ether, and only partially in carbon disulphide. Its solution in the latter is coloured violet-blue with bromine, and its alcoholic solution on addition of hydrochloric acid slowly assumes a violet tint, but the reaction is not nearly so marked as that obtained from the resin of galbanum.

Myrrh also contains a small quantity of bitter principle, which rapidly reduces cupric ammonium tartrate.

Other varieties of Myrrh.—As imported, myrrh varies much in appearance, and is frequently separated or picked over at Aden or Bombay. It is frequently mixed with other gum-resins obtained from different species of Balsamodendrons growing in the same districts. Arabian Myrrh contains more gum than Somali Myrrh, and has a more polished appearance.

Burseraceæ or Amyridaceæ.

Bissa Bol closely resembles myrrh in appearance, having also white streaks in it; but its odour and taste are disagreeable and quiet distinct from that of myrrh.

Bdellium is a gum-resin, of which there are three varieties, namely, East Indian Bdellium, obtained from *Balsamodendron Mukul* and *Balsamodendron Roxburghii*, both species being indigenous to India; and African Bdellium, the exudation of *Balsamodendron Africanum*, indigenous to Eastern Africa; and Opaque Bdellium. The first has an odour resembling cedar, and softens when held in a warm hand; the second is hard, with a resinous fracture and often a white powdery surface; the third is opaque, and has, like the Indian Bdellium, a very acrid taste.

Therapeutics.—Stimulant, Aromatic, Tonic, and Antiseptic.

Used in the preparation of *Decoctum Aloes Compositum*, *Pilula Aloes et Myrrhæ*, *Pilula Asafœtidæ Composita*, *Pilula Rhei Composita*, *Mistura Ferri Composita*, and *Tinctura Myrrhæ*.

No. 52. Elemi. *Manila Elemi.*

A concrete resinous exudation probably obtained from *Canarium commune*. The actual botanical source of this drug is undetermined. Chiefly imported in barrels from Manila.

Habitat.—Manila and neighbouring Philippine Islands, where the tree is indigenous.

Characters.—When fresh, it is soft, granular, resinous, and colourless, but by keeping it becomes harder, and of a pale yellow tint. Odour strong and fragrant, somewhat resembling fennel and lemon, taste aromatic, warm and acrid. Moistened with rectified spirit, it breaks up into small particles, which, when examined by the microscope, are seen partly to consist of acicular crystals.

Composition.—Elemi contains a volatile oil, two resins, also neutral principles soluble in water, and elemic acid. Elemi on distillation yields 10 per cent. of fragrant, colourless volatile oil, which is neutral and strongly dextrogyrate.

Burseraceæ or Amyridaceæ.

Of the two resins one called Breine is soluble in cold alcohol, from which it crystallises on slow evaporation. This is present in very small quantity only. The other resin is insoluble in cold alcohol, but is dissolved by boiling alcohol, and crystallises out on cooling; the crystals, repeatedly washed with cold spirit, and finally recrystallised from boiling spirit, constitute pure Amyrin, of which Elemi contains at least 25 per cent.

Bryoidin, $C_{20}H_{38}O_3$, a neutral substance, is deposited from the aqueous solution on cooling, after the distillation of the essential oil; the crystals are purified by recrystallisation from ether, in which they are readily soluble. Bryoidin is soluble in alcohol, boiling water, cold ether, and fixed oils; the crystals sublime unchanged, and fuse at $272^{\circ} F$. They have a bitter taste.

Bréidin is obtained from the aqueous solution after separation of Bryoidin, on removing the solution, filtering, cooling it, and subsequently warming the liquid. It differs from Bryoidin in the absence of bitter taste; in other characters it closely resembles it, and, like it, is present only in small quantity.

Elemic acid, $C_{35}H_{56}O_4$, has also been isolated in small quantity from Manila Elemi. It is crystalline, and melts at $419^{\circ} F$.

The alcoholic solution of Elemi gives a violet colour with a solution of bromine in chloroform.

Varieties.—Under the name of Elemi several resinous products are occasionally imported into this country, probably all produced by plants of the Nat. Ord. Burseraceæ; the following are a few of them:—

1. Brazilian Elemi.—This resin is yielded by *Icica Icicariba*, and other species. It is a soft yellowish solid, with an agreeable terebinthinate odour.

2. Mauritius Elemi, obtained from *Colophonia mauritiana*, closely resembles Manila Elemi, but remains longer fluid after exudation.

Burseraceæ or *Amyridaceæ*.

3. Mexican Elemi, obtained probably from *Amyris elemifera*, occurs in dark or pale yellow masses, brittle, and having an oily fracture, and when masticated readily softens.

Therapeutics.—Externally as a stimulant to sluggish sores.

Used in the preparation of Unguentum Elemi.

No. 53. Olibanum. *Frankincense*.

(*Not official*.)

A gum resinous exudation obtained from several species of *Boswellia*—chiefly from *B. Bhau-Dajiana*, *B. Carterii* (a polymorphic species), and *B. Frereana*, the latter yielding the Frankincense in whitish masses, not in tears, and probably other species.

Habitat.—Nubia, Abyssinia, and Southern Arabia; but Frankincense is collected chiefly in Somaliland, and a little in South Arabia.

Collection.—The Somalis, who collect this gum-resin, make a long deep incision into the bark, generally twice a year. On exuding, the gum-resin appears as a milky fluid, which rapidly hardens, and is then collected. The finer tears are separated from those of inferior quality. It is collected during the dry seasons, and is shipped to this country by way of Aden or Bombay.

Characters.—Olibanum is generally found in irregularly shaped tears, of a roundish form; in colour white or pale yellow, frequently marked with spots, and covered with a white powder, formed by the attrition of the tears; fracture conchoidal, waxy; taste slightly bitter and balsamic; odour fragrant, intensified on heating. When triturated with water it forms a nearly white emulsion. Inferior Olibanum is much darker in colour, and frequently pieces of the bark remain attached to the tears.

Composition.—Resin, volatile oil, and gum. The gum on being dissolved in water gives reactions with plumbic

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acetate, and borax, similar to those given by gum acacia. It is present to the extent of about 30 per cent.

Volatile Oil.—Obtained on distillation in varying quantities, from 4 to 7 per cent. It is composed of two hydrocarbons, of which Olibene, $C_{10}H_{16}$, is the principal constituent, and the other an oxygenated hydrocarbon.

Olibene, dissolved in carbon disulphide, and treated with dry hydrochloric acid gas, forms a monohydrochloride, similar to terebenthene.

The resin is not uniformly distributed throughout the tears, which often present a stratified appearance. When extracted by alcohol the quantity varies from 57 to 75 per cent., and has the composition of $C_{20}H_{30}O_3$. It is insoluble in potassium hydrate solution. When treated for some time with nitric acid it yields camphresinic acid, $C_{20}H_{14}O_7$.

Therapeutics.—Stimulant and rubefacient; used chiefly for incense.

LEGUMINOSÆ (Papilionæ).**No. 54. Glycyrrhizæ Radix. *Liquorice or Licorice Root.***

The root and underground stems, fresh and dried, of *Glycyrrhiza glabra*. There are several marked varieties of this species, one of which, var. *typica*, is indigenous to Southern Europe, cultivated in Germany, France, and England; another, var. *glandulifera*, is found principally in Central and Northern Europe.

Habitat.—Cultivated in Yorkshire and at Mitcham.

Characters.—When fresh, in long cylindrical pieces of varying thickness, smooth and yellowish-brown or somewhat reddish externally, yellow and juicy internally, very flexible, easily cut, and consisting of a thick cortical portion surrounding a central woody axis, which in the case of the stem contains a small pith. Odour peculiar, earthy, and somewhat sickly; taste strong, peculiar, sweet. When dried it is either peeled or unpeeled. In the latter case it has essentially the same character as the fresh root, except

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that it is somewhat darker, furrowed longitudinally, and has a slightly acrid, and, in some cases, a feebly bitter taste, combined with the characteristic sweetness; but when peeled it has a yellow colour externally, and there is no acidity.

Radix Glycyrrhizæ Russica.—This root is mainly obtained from var. *glandulifera*, but *Glycyrrhiza echinata* is cultivated in Russia as well. Russian Liquorice consists chiefly of the main root, and a few stolons, and is about 8 to 16 inches in length, and 1 to 4 inches thick. Sometimes deprived of its dark brown corky layer; colour greyish-yellow; wood fibrous, soft, and porous; taste sweet, and afterwards slightly bitter.

Composition.—Glycyrrhizin; sugar; starch; acrid, oily resin; and glycyramarin.

Glycyrrhizin or Glycyrrhizic Acid, $C_{44}H_{63}NO_{18}$. This glucoside is extracted by boiling water from the root. The decoction is concentrated and acidulated with sulphuric acid, when it is slowly deposited; the precipitate is collected and washed with water. The impure glycyrrhizin is then dissolved in glacial acetic acid, from which it crystallises in sphæro-crystalline masses of prismatic needles. Pure glycyrrhizin is only sparingly soluble in cold water, but soluble in solution of ammonia, forming ammoniated glycyrrhizin, $(NH_4)C_{44}H_{62}NO_{18}$, which, on evaporation, can be obtained as a scale preparation. Glycyrrhizin on hydrolysis with warm dilute sulphuric acid, yields glycyrretin, $C_{32}H_{47}NO_4$, and para-saccharic acid, $C_6H_{10}O_8$.

Glycyramarin, $C_{36}H_{57}NO_{13}$. This principle is obtained from the crude ammoniated glycyrrhizin by treating it with ethyl alcohol, which dissolves it; on careful evaporation, it is left as an amorphous residue; it has a bitter taste.

The acrid resin is soluble in alcohol and glacial acetic acid, and on fusing with caustic potash yields paraoxybenzoic acid.

Asparagine, $C_4H_8N_2O_3$, occurs in small quantities; on boiling with dilute hydrochloric acid it yields aspartic acid and ammonia.

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Radix Glycyrrhizæ Indicæ. Indian Liquorice Root is obtained from *Abrus precatorius*. It is not used in this country. It does not resemble English Liquorice root.

Seeds of Indian Liquorice.

Semen Abri.—Jequirity seeds or Prayer Beads have been recently employed in certain ophthalmic diseases. They contain an alkaloid and a peculiar albuminous principle.

Therapeutics.—A sweet demulcent.

Used in the preparation of *Confectio Terebinthinæ*, *Decoctum Sarsæ Compositum*, *Extractum Glycyrrhizæ*, *Extractum Glycyrrhizæ Liquidum*, *Infusum Lini*, *Pilula Hydrargyri*, *Pilula Ferri Iodidi*, *Pulvis Glycyrrhizæ Compositus*.

No. 55. Chrysarobinum. Chrysarobin.

Is a mixture of proximate principles extracted from Araroba (Goa powder) which is a powdery substance deposited in the heart-wood of the stem of *Andira Araroba*.

Habitat.—*Andira Araroba* is a large leguminous tree found in Brazil and the damp forests of Bahia.

Characters.—As Goa powder, and the extract obtained from it, are frequently mistaken for one another, they will be described separately. This same mistake has crept into the present Pharmacopœia, the source given being that of Goa powder, whilst the characters described apply to Chrysarobin.

Araroba, or Goa powder, as met with in commerce, is a rough, dirty, yellowish or brownish powder, frequently mixed with lumps, which, when broken, present a canary-yellow colour internally; the taste is slightly acrid and bitter. When a portion is heated between two watch-glasses, the upper one is covered with a fine crystalline sublimate, which gives a bright-red colour on addition of solution of ammonia. Araroba is obtained by cutting down the trees and splitting the wood, and removing the powder from the cavities. It is found only in the heart-wood and throughout its entire mass, and appears to be produced by a physico-chemical process which causes a

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metamorphosis of the woody tissue. On exhaustion with boiling benzol it loses about 80 per cent. of its weight, and on incineration leaves nearly .5 per cent. of ash.

Chrysarobin is a light brownish-yellow finely crystalline powder, tasteless, odourless, permanent in the air, very sparingly soluble in water, more so in alcohol (7 per cent.), readily in ether or boiling benzol. When heated to about 320° F. it first melts and then partly sublimes, and the residue, on further ignition, leaves no ash. It is soluble in alkalies, forming a yellowish-red fluorescent solution, which is changed to a dark red on passing a current of air through the solution. Sulphuric acid dissolves it, forming a blood-red solution, and on the addition of water it is re-precipitated.

Composition.—Chrysarobin, as obtained from araroba, by exhaustion with boiling benzol, is not quite pure; it can be purified by crystallisation from glacial acetic acid, from which it separates in yellow scales. Chrysarobin was formerly regarded as chrysophanic acid, until it was ascertained to be a definite principle now named chrysarobin or chrysophan, $C_{30}H_{26}O_7$, which may be regarded as potential chrysophanic acid. Its alkaline solution on agitation with oxygen or air yields chrysophanic acid. Chrysophanic acid is also found in rhubarb, senna, and various other drugs, and is one of the chief constituents of the yellow colouring matter of many lichens. It is precipitated from its alkaline solutions by mineral acids, and crystallises from chloroform in minute yellow needles. When chrysophanic acid is acted on by reducing agents it yields a product to which the name anthrarobin is applied, this substance is now prepared in considerable quantities from alizarin and purpurin by boiling alizarin with zinc dust and ammonia and filtering the solution into hydrochloric acid, when the anthrarobin is precipitated. It is a yellowish-white powder soluble in alkalies and glacial acetic acid.

Therapeutics.—Chrysarobin is as frequently prescribed as chrysophanic acid, and is used in cases of psoriasis and other skin diseases; internally it acts as a purgative.

Official Preparation.—Unguentum Chrysarobini.

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No. 56. Indigo. *Indigo.*

A blue pigment extracted from various species of *Indigofera*, the most important being *Indigofera tinctoria* and *I. argentea*; it is also obtained from *Polygonum tinctorium* (*Polygonaceæ*), and *Isatis tinctoria* (*Cruciferæ*).

Habitat.—Cultivated in tropical and sub-tropical countries; largely imported from India.

Preparation.—The twigs and leaves are collected, chopped, and macerated in water for some time, when fermentation takes place; after a time the liquid is decanted and poured into shallow vessels, and exposed to the air, being repeatedly agitated, so as to facilitate the oxidation of the chromogen indican, and thus cause the crude indigo to be deposited. The supernatant liquid is decanted, and the precipitated indigo collected, pressed, and dried. This constitutes commercial indigo.

Characters.—Indigo is generally met with in hard, brittle, porous masses, or in cubical cakes, of a deep blue colour, tasteless, and inodorous. Commercial indigo is very impure, containing indigo gluten, indigo red, and indigo brown. It is readily soluble in strong sulphuric acid, insoluble in alcohol or acetic acid.

Purification.—Indigo is purified by reducing it to indigo white with grape sugar, putrefying organic matter, or ferrous salts, treating the resulting indigo white with alkalies in which it is soluble, and allowing the solution to remain exposed to the air, when it slowly deposits minute crystals of indigo blue.

It is sometimes purified by sublimation, but this process is always attended with considerable loss.

Composition.—Commercial indigo contains indigo blue or indigotine, varying in amount from 50 to 70 per cent.; it also contains indigo gluten, soluble in dilute acetic acid; indigo brown, soluble in solution of potassium hydrate; and indigo red, or resin, soluble in alcohol. On incineration it yields from 5 to 7 per cent. of ash.

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Indigo blue or indigotine, $C_{19}H_{10}N_2O_2$, is obtained on the hydrolysis of the natural glucosidal body, indican, which at the same time yields a variety of sugar, indiglucin, which does not undergo fermentation, but rapidly reduces cupric ammonium tartrate solution.

Indigo sulphate or sulphindigotic acid is prepared by dissolving indigotine in strong sulphuric acid, and is used as a test reagent.

Adulterations.—As this is an important commercial pigment or dyestuff it is very liable to sophistication. A good sample ought not to yield more than 8 per cent. of ash. Prussian blue adds to the amount of ash, and can be detected by triturating the powder with a solution of sodium hydrate, which does not affect the colour of indigo, but precipitates ferric hydrate, and the solution filtered and acidified with hydrochloric acid will give reactions with ferrocyanide of potassium.

Gum, dextrin, and starch are sometimes mixed with indigo. They yield adhesive solutions and char with strong sulphuric acid.

Official Preparation.—Solution of Indigo Sulphate.

No. 57. Tragacantha. *Tragacanth.*

A gummy exudation obtained by making incisions in the stem of *Astragalus gummifer* and other species.

Habitat.—Most of the species are low shrubs, indigenous to Greece, Asia Minor, and Persia.

Secretion.—From a series of elaborate researches, Von Mohl proved that tragacanth is a product of the metamorphosis of the incrusting layers of the cell-walls, composing the medullary rays and pith of the stem. This gummy substance is contained in the plant under considerable pressure between the woody wedges, and when incisions are made or a branch broken it exudes with some force.

Collection.—Tragacanth is obtained by natural exudation or by incision. That which exudes spontaneously assumes

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an irregularly globular or conical shape, and rapidly hardens, acquiring a yellowish-brown colour; formerly commercial tragacanth was the naturally exuded gum, more recently the peasants are in the habit of puncturing the bark and wood, or of making deep incisions right into the pith, after which the gum exudes rapidly, and in three or four days it is collected in flakes.

Characters.—Tragacanth occurs in white or somewhat yellowish flaky pieces, varying in length and breadth, and consisting of different layers, and marked with parallel ridges; the flakes are then irregularly oblong or roundish, spirally twisted, or in curved narrow bands, translucent, tough, inodorous, and tasteless, difficult to powder, unless the temperature is raised to 120° F. It is sparingly soluble in water, but swells up into a gelatinoid mass; with a large quantity of water it forms a ropy liquid which is tinged violet or blue with iodine, and acquires a yellow colour on the addition of caustic soda; the solution is precipitated on the addition of alcohol and warm solution of basic plumbic acetate.

Composition.—Tragacanth contains two gums, one soluble and the other insoluble; it also contains from 13 to 20 per cent. of water, and yields, on incineration, $2\frac{1}{2}$ to $3\frac{1}{2}$ per cent. of ash. According to Giraud, this gum is principally composed of pectose, or a body nearly related to it, which, on treatment with water, yields a soluble pectin.

The soluble gum differs from arabin in giving a precipitate with neutral plumbic acetate, and forming a clear mixture when added to a solution of borax; but it is apparently closely allied to arabin, as it gives the same precipitates with ammonium oxalate solution and with rectified spirit.

The insoluble gum has been named respectively Tragacanthin, Adraganthin, and Bassorin. It is soluble in solutions of ammonia and the fixed alkalies, also in hydrochloric acid.

Adulteration.—Sophistication of this gum is sometimes carried on at Smyrna with inferior sorts of tragacanth locally known as Caramania or Mosul Gums. The Cara-

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mania gum is in angular pieces of a dirty-white colour, hence it is damped by steaming and then whitened with lead carbonate or chalk. This variety is used to adulterate the small tragacanth "sorts." Mosul gum is found in nodular masses of a dull brown colour; prior to using it for admixture it is broken up.

Caramania gum may be recognised by occurring in small angular pieces.

Official Preparations.—Confectio Opii; Confectio Sulphuris; Glycerinum Tragacanthæ; Mucilago Tragacanthæ; Pulvis Opii Compositus; Pulvis Tragacanthæ Compositus.

No. 58. Setæ Mucunæ. Cowhage.

(*Not official.*)

The hairs removed from the outer surface of legumes of *Mucuna pruriens* (*Dolichos pruriens*).

Habitat.—Found growing wild throughout the tropical regions of India, America, and Africa; it is also cultivated in the East and West Indies.

Characters.—The legumes are from 2 to 5 inches in length, and when immature present a downy appearance; finally the hairs increase in size, varying from $\frac{1}{10}$ to $\frac{1}{8}$ of an inch in length, become rigid, sharply pointed at the apex, and of a glossy brown colour, and mostly filled with a brown granular secretion. When applied to the skin the sharp points penetrate the pores and set up an unbearable itching, which is partly alleviated on applying oil.

Composition.—The hairs contain a small quantity of tannic acid and resin, but little is known of the composition of the latter.

No. 59. Scoparii Cacumina. Broom Tops.

The fresh and dried tops of *Cytisus Scoparius* (*Sarothamnus Scoparius*).

Habitat.—Indigenous to Europe and Great Britain.

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Characters.—Broom Tops are long, thin, branched, straight, flexible, pentangular, winged, dark green or yellowish-green, smooth, not spiny, generally free from leaves, but if leaves are present, sessile, small and simple above, stalked and trifoliate below. Taste bitter and disagreeable; odour when fresh and broken, peculiar; when dry, almost inodorous.

Composition.—Broom Tops contain Scoparin and Sparteine and a bitter principle.

Scoparin, $C_{21}H_{22}O_{10}$. This principle is isolated from a concentrated decoction which is allowed to stand until it gelatinises. This gelatinous mass is washed with cold water and dissolved in boiling water, from which it again separates. It is purified from chlorophyll by treatment with weak hydrochloric acid; finally it is dissolved in hot alcohol, from which it separates. When dried it forms an amorphous, pale yellow, crystalline powder. When fused with caustic potash it yields protocathechuic acid and phloroglucin.

Sparteine, $C_{15}H_{26}N_2$, is best prepared by percolating the bruised tops with acidulated water, concentrating the solution, and distilling with caustic potash. It is freed from ammonia, which distils over at the same time, by collecting the distillate in dilute sulphuric acid, and carefully evaporating the solution; the mixed sulphates are then exhausted with absolute alcohol, which removes the sparteine sulphate; this is recovered and distilled with potash. Sparteine is an oily liquid, colourless when first prepared, turning brown by keeping. It has a strong alkaline reaction, and persistent bitter taste. Reinsch also isolated a bitter principle.

Allied Species.—The Spanish Broom, *Cytisus juncus*, closely resembles the preceding species. The stems and branches are cylindrical and smooth, and are thus distinguished from the angular tops of the official broom. It flowers in July, but *Cytisus Scoparius* in May.

Therapeutics.—Scoparin is a diuretic, Sparteine a cardiac tonic.

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Used in the preparation of Decoctum Scoparii, and Succus Scoparii.

No. 60. Pterocarpi Lignum. *Red Sandal Wood.*

The sliced or rasped heart-wood of *Pterocarpus santalinus*.

Habitat.—This small tree grows wild in the forests of the Madras Presidency, but is cultivated in Southern India and Ceylon.

Characters.—As imported, Red Sandal Wood is met with in heavy, hard billets, from which the light coloured sap-wood has been removed. The wood is valued for turnery. As met with in Pharmacies it occurs in raspings, or a coarse, irregular, brown-red powder, with a sparingly astringent taste, and when rubbed it emits a peculiar odour. On heating, a dark reddish mass exudes. When macerated in water the solution remains colourless, but it yields to alcohol a deep red solution.

Composition.—Red Sandal Wood contains a colouring principle, santalic acid or santalin, also santal and pterocarpin, with minute traces of tannic acid.

Santalic Acid or Santalin, $C_{15}H_{14}O_5$ (Gmelin), is the principal constituent, and is best extracted by precipitation from a tincture of the wood by addition of basic plumbic acetate, suspending the precipitate in alcohol, precipitating the lead with a current of sulphydric acid gas, filtering and evaporating, when it crystallises in very minute needles of a red colour. Santalin is soluble in ether, forming a yellow solution, and in alcohol affords a red solution; with weak aqueous potash solution it gives a violet colour, from which barium chloride throws down a violet-coloured precipitate. It differs from alizarine in not subliming, in its melting-point, and in yielding no anthracene when reduced.

Santal, $C_8H_6O_3$, is extracted by boiling water rendered faintly alkaline with potash; it is precipitated from its solution by mineral acids, and when dissolved in alcohol it crystallises out in colourless scales.

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Pterocarpin, $C_{17}H_{16}O_5$, differs from Santal in being soluble in carbon disulphide and chloroform.

Therapeutics.—It is chiefly used as a colouring matter.

Used in the preparation of Tinctura Lavandulæ Composita.

No. 61. Kino. Kino.

The juice obtained from incisions made in the trunk of Pterocarpus Marsupium, and inspissated without artificial heat.

Pterocarpus Indicus yields also a kino, which is sometimes exported to this country in a semi-liquid state.

Habitat.—Indigenous to India and Ceylon.

Collection.—The tapping of the trees is carried on in the Government forests of the Malabar coast, under certain restrictions and a small fee is always charged. The collector makes a long perpendicular incision, and a number of lateral ones running into it; at the base of the incision a vessel is placed to receive the exuding kino, which is of a bright red colour; it is then dried by exposure to the sun and air, and afterwards packed for shipping.

Characters.—Kino consists of small irregular glistening opaque reddish-black brittle fragments about the size of a pea, which in thin laminæ, and at the edges, are ruby red and transparent; it is inodorous, with a very astringent taste, and softens on chewing, tinging the saliva a blood red. Almost entirely soluble in alcohol, partly soluble in water, leaving a flocculent residue.

Composition.—Kino contains kino-tannic acid and minute quantities of pyrocatechin; it also contains kino-red. It does not contain any catechuic acid. Kino-tannic acid is closely related to the tannin of catechu. Its aqueous solution gives a violet colour with neutral ferrous sulphate. On fusing with caustic potash it yields protocatechuic acid and phloroglucin. An aqueous solution of kino when agitated with reduced iron slowly acquires an intense violet colour; this reaction is observed with numerous astringent bodies. The aqueous solution on standing slowly deposits kino-red.

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Kino, when boiled with diluted hydrochloric acid, and the cold decoction agitated with ether, and the ethereal layer allowed to evaporate, deposits white crystals of kinoin. On incineration kino yields about 2 per cent. of ash.

Besides kino-tannic acid, the other substances present in kino are of value to the tanner.

Other Varieties of Kino.

1. Botany Bay Kino, obtained from *Eucalyptus resinifera*, *E. rostrata*, *E. corymbosa*, and others. Natural order Myrtaceæ.

2. Jamaica or West Indian Kino, obtained from *Coccoloba uvifera*. Natural order Polygonaceæ. This kino is prepared by boiling the chips of wood and bark, and evaporating the decoction. It yields 90 per cent. of its weight to water.

3. African or Gambia Kino, obtained from *Pterocarpus erinaceus*. It is not often met with in commerce.

4. Bengal or Palas Kino, obtained from *Butea frondosa*. Natural order Leguminosæ

5. American Kino. This is an extract, said to be prepared by boiling the roots of different species of *Krameria* and evaporating the decoction.

Therapeutics.—Astringent, used for diarrhœa and diseases of the mucous membrane.

Used in the preparation of *Pulvis Kino Compositus*; *Tinctura Kino*; and *Pulvis Catechu Compositus*.

No. 62. Balsamum Peruvianum. *Balsam of Peru.*

A balsam exuded from the trunk of *Myroxylon Pereiræ* after the bark has been beaten, scorched, and removed.

Habitat.—San Salvador in Central America, where the trees grow to a height of 50 or 60 feet.

Collection.—The native Indians commence the collection of the balsam just after the rainy season, about the beginning of December. The bark, for a considerable distance up the trunk of the tree, is well beaten with a blunt

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instrument until it is completely separated from the wood ; this is done on four sides, allowing an interspace of untouched bark to remain, so as not to kill the tree. A week afterwards the bark is scorched with burning torches, and in a few days is easily removed. The exposed surface of the wood is now covered with rags, or any suitable absorbent material, which take up the exuding balsam, and these, when saturated, are gently boiled in water, when most of the heavy balsam sinks ; the rags are now removed, and placed in a bag made of rope, and thoroughly squeezed by twisting, until no more balsam exudes. This process is repeated as long as any balsam exudes from the trunk. The water is then decanted from the balsam, which is bottled and carried to the coast. Balsam of Peru is principally exported from the port of Acajutla, but some from Lima or Valparaiso.

Characters.—Balsam of Peru is a viscid liquid, of the consistency of treacle ; of a dark brown-black colour when examined in quantity, but in thin layers a deep reddish brown, and transparent. Odour agreeably aromatic, and slightly smoky, particularly on warming. It has an acid reaction. Taste somewhat bitter and acrid, followed by a burning sensation in the throat. Sp. gr. 1.15 to 1.16. It is soluble in alcohol, chloroform, acetone, and glacial acetic acid. When agitated with petroleum ether it does not form a permanent mixture, and the clear portion on separation leaves a pale yellow liquid (cinnamein). It is insoluble in water, but imparts a slightly acrid taste to water when agitated with it.

Composition.—Balsam of Peru is a complex mixture, containing benzoic and cinnamic acids, combined with benzylic alcohol and resin.

Cinnamein or Benzylic Cinnamate, $C_9H_7(C_7H_7)O_2$. This aromatic compound ethereal is the principal constituent in the balsam, amounting to nearly 60 per cent., and is readily extracted by agitating the balsam with twice its volume of petroleum ether, decanting the clear supernatant liquid, and carefully removing the petroleum ether with a gentle heat : the almost colourless residue is cinnamein. It has an

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agreeable fragrant odour, and aromatic taste ; on agitation with a solution of alkaline hydrate, it is saponified, yielding pure benzylic alcohol, $C_6H_5CH_2OH$, and cinnamate of the alkali, from which cinnamic acid is precipitated on the addition of hydrochloric acid. Cinnamein is prepared artificially by agitating together sodium cinnamate, benzylic bromide, and alcohol, filtering and evaporating, and allowing to stand, when it crystallises out, in which character it differs from the natural product.

Cinnamic acid C_8H_7COOH , and Benzoic acid C_6H_5COOH , are easily removed by agitating the balsam with solution of ammonia, separating the solution, and precipitating the mixed acids with hydrochloric acid. It is difficult to separate cinnamic acid from benzoic acid ; but when an acidulated solution of the acids is agitated with potassium permanganate the cinnamic acid is decomposed, yielding benzylic aldehyd, the benzoic acid being unaffected.

The resin is best separated by agitating the balsam with three times its volume of carbon bisulphide, when it is precipitated. When collected and dried it is a black, amorphous brittle mass. It is soluble in alcohol, and the solution reddens litmus. When destructively distilled it yields toluol, styrol, and benzoic acid. The resin when fused with caustic potash yields protocatechuic acid.

Adulterations.—Balsam of Peru is very frequently submitted to a systematic adulteration with fixed oils, copaiba, turpentine, resin, alcohol, gurgun balsam, storax, and benzoin. Numerous tests of its purity have been proposed from time to time. The following give good results:—When the balsam is agitated with twice its volume of water it ought not to diminish in volume (absence of alcohol). Should alcohol be present, distil a little of the balsam with water, and add to the distillate a little caustic soda and iodine, and set aside ; on cooling minute crystals of iodoform will separate. On triturating 10 drops of the balsam with 20 drops of sulphuric acid, a tough homogeneous cherry-red mixture results, which, on treating with cold water, is converted into a hard brittle amorphous mass (absence of oleo-resins and fixed oils) which is entirely soluble in ether (absence of storax and benzoin). On mixing the balsam with three

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times its volume of carbon bisulphide, a black-brown resin is precipitated, which should weigh nearly 40 per cent., and the clear liquid should only have a faint fluorescence (absence of gurgun balsam). When 5 drops of balsam are added to a fluid drachm of ammonia solution, and agitated, a slight, rapidly disappearing froth should be produced, and the mixture, on standing for twenty-four hours, should form a stiff jelly (absence of resin, Canada balsam, and turpentine). When agitated with 5 times its volume of benzene, and a little of the clear portion decanted and allowed to evaporate, it will leave an oily residue, which on being heated should not evolve the odour of copaiba, turpentine, or storax.

White Balsam of Peru is prepared in San Salvador by submitting the legumes of *Myroxylon Pereiræ* to pressure. It is obtained as a golden yellow, granular, semifluid mass, becoming hard on keeping, having an odour resembling tonka beans. It contains a crystalline resin, *Myroxocarpin*, $C_{24}H_{34}O_3$. This is not an article of commerce in England.

Therapeutics.—Stimulant and expectorant.

No. 63. Balsamum Tolutanum. *Balsam of Tolu.*

A balsam which exudes from the trunk of *Myroxylon Toluifera*, after incisions have been made in the bark.

Habitat.—Found growing in the high plateaux of New Granada and Venezuela.

Collection.—Two long slanting incisions are made through the bark, and finally meet at their lower end, forming an angle underneath. Below this cut, the bark and wood are a little hollowed out, so as to allow of a calabash cup being inserted to collect the balsam. The cups are emptied into leather bags, and then carried to the coast, where the balsam is run into tin drums for exportation.

Characters.—When imported, Tolu Balsam is a soft, tenacious solid, gradually hardening, and becoming quite brittle in cold weather. In thin laminæ it is perfectly transparent, and of a yellowish or reddish-brown colour. When pressed between glass plates, and examined under the microscope,

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numerous crystals of cinnamic acid are visible. Odour fragrant and aromatic, faintly resembling vanilla; taste aromatic. It is soluble in alcohol, and the solution has an acid reaction.

Composition.—The principal constituent of Tolu Balsam is an amorphous resin, which is insoluble in carbon bisulphide. It contains nearly 8 per cent. of cinnamic and benzoic acids. When it is submitted to distillation with water it yields about 1 per cent. of a hydrocarbon, toluene, $C_{10}H_{16}$, which is a thin colourless liquid, odour aromatic, taste warm and acrid.

The resin on destructive distillation yields styrol, toluol, and phenol.

Adulteration.—Turpentine resin is sometimes mixed with the balsam. When the balsam is triturated with twice its volume of strong sulphuric acid, it becomes of a cherry red colour, but if turpentine is present it will be black. Turpentine is also removed if the balsam adulterated with it be shaken with carbon bisulphide.

Therapeutics.—Stimulant and expectorant.

Used in the preparation of *Pilula Phosphori*; *Syrupus Tolutanus*; *Tinctura Tolutana*; and *Tinctura Benzoini Composita*.

No. 64. *Physostigmatis Semen. Calabar Bean.*

The dried seed of *Physostigma venenosum*.

Habitat.—This plant is found growing on the banks near the mouths of the Niger and Old Calabar Rivers, in the Gulf of Guinea, Western Africa. It is also cultivated in India and Brazil, where it was introduced some years since.

Characters.—From about 1 in. to $1\frac{1}{4}$ in. long, $\frac{3}{4}$ of an inch broad, and $\frac{1}{2}$ an inch or somewhat more in thickness; oblong and more or less reniform, and with a long, broad, blackish furrow running entirely along its concave side. Testa hard, brittle, roughish, deep chocolate-brown or brownish-red, and enclosing a closely adhering nucleus which principally con-

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sists of two hard, white, brittle cotyledons, separated from each other by a somewhat large cavity. Inodorous, and has no marked taste beyond that of an ordinary bean. It yields its virtues to alcohol, and imperfectly to water. The cotyledons when moistened with solution of potash acquire a permanent pale yellow colour.

Composition.—Calabar Bean contains two powerfully poisonous alkaloids: physostigmine or eserine, and calabarine; and a neutral body, phytosterin.

Physostigmine or Eserine, $C_{15}H_{21}N_3O_2$. This alkaloid is best extracted by thoroughly exhausting the crushed seeds with alcohol containing a little tartaric acid, recovering the alcohol by distillation, dissolving the acid alcoholic extract in water, and repeatedly agitating this solution with ether as long as the ether removes any colour. To the aqueous solution is now added a solution of sodium bicarbonate, avoiding excess, and on again agitating twice with ether, separating the ethereal layer, and carefully evaporating in a water-bath, an almost colourless amorphous residue of physostigmine is left. It can be purified by redissolving in water acidulated with hydrochloric acid, reprecipitating with sodium bicarbonate, and agitating with benzol, removing the supernatant layer, and allowing it to slowly evaporate, when the physostigmine crystallises in fine silky needles. Physostigmine is sparingly soluble in water, and the solution has a strongly alkaline reaction; when agitated with weak solution of potash the liquid acquires a red colour, due to rubreserine, and changing to blue on evaporation. Physostigmine is readily soluble in alcohol, chloroform, carbon bisulphide, benzol, and in dilute acids, the latter solution being dichroic.

Colour Reactions of Physostigmine.

Solution of Chlorinated Lime ...	Red.
Strong Sulphuric Acid ...	{ Yellow, changing to olive-green.
Ammonia added to its solution, and then warmed on a water- bath, gives a change of colours.	
	{ Red, yellow, green, and finally blue.

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Calabarine.—This alkaloid is best prepared by precipitating the aqueous solution of the extract with a solution of potassio-mercuric iodide, collecting the precipitate, washing it with cold water, and then boiling it with alcohol once or twice, which removes the physostigmine precipitate, leaving the calabarine compound, which is decomposed with baryta water, carefully evaporating to dryness, and the residue treated with absolute alcohol, which removes the calabarine. Calabarine is almost insoluble in ether, and differs from physostigmine in its physiological action, being more allied, in this respect, to strychnine.

Phytosterin is obtained by evaporating the ethereal solution, decanted after agitation of the acid aqueous solution of the extract in preparing physostigmine. It is a neutral substance, and dissolves readily in petroleum ether, from which it crystallises in fine needles. It is closely allied to cholesterine.

Rubreserine is prepared by allowing physostigmine to remain in contact with caustic potash for some time. The solution acquires a red colour; it is then agitated with chloroform, and the chloroformic solution removed, and on standing rubreserine crystallises out. It is insoluble in ether.

The seeds on incineration leave 3 per cent. of ash, mainly composed of potassium phosphate.

Adulteration.—Calabar Bean is not subject to a systematic sophistication. Occasionally the seeds of another species, *Physostigma cylindrospermum*, are met with. They are longer, and more cylindrical. When the cotyledons are moistened with potash solution they assume a deep yellow colour.

The seeds of a species of *Mucuna*, and other leguminous plants, are sometimes sent over to this country as Calabar beans, but in size and character they bear no resemblance to the genuine article.

Dose in powder—1 to 4 grains.

Used in the preparation of *Extractum Physostigmatis*.

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No. 65. Semen Fœni-græci. Fœnugreek.

(*Not official.*)

The seeds of *Trigonella Fœnum-græcum*.

Habitat.—Fœnugreek is an annual, indigenous to Asia Minor, and has become naturalised in Southern Europe and Northern and Eastern Africa.

Characters.—The seeds are contained in linear curved flattened legumes, and vary in number from 12 to 20. They are about one-eighth of an inch long, having a rhomboidal form; they are flattened, hard, and of a pale brownish-yellow colour. The hilum is situated on the sharper edge, from which there runs a deep furrow, almost dividing the seed into two unequal lobes. Odour strong, resembling that of celery seed or of the bark of *Ulmus fulva*. Taste bitter. When macerated in water the testa bursts, on account of the rapid enlargement of the endopleura as a gelatinous sac, containing the cotyledons and their prominent radical.

Composition.—Fœnugreek contains a considerable proportion of mucilage, yielded by the integuments of the seed to the amount of 30 per cent. The testa also contains some tannin. The cotyledons contain a bitter acrid resin, soluble in amylic alcohol, and they yield to ether about 6 per cent. of an intensely fœtid, disagreeable, fatty oil, which has a persistent bitter taste.

Adulteration.—Powdered Fœnugreek is frequently adulterated with farinaceous substances, which are readily detected by the iodide of starch reaction.

The seeds of other species of *Trigonella* are occasionally met with; although similar in properties they are much smaller in size.

Production.—Although Fœnugreek is largely cultivated in the South of France and Morocco, the bulk is produced in Egypt, and shipped at Alexandria.

Uses.—Chiefly used in the manufacture of cattle foods; also in curry powder.

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Sub-Order Cæsalpinieæ.

No. 66. Hæmatoxyli Lignum. Logwood.

The sliced heart-wood of *Hæmatoxylon Campechianum*.

Habitat.—The logwood tree, which attains a height of 30 or 40 feet, is indigenous to Central America, particularly to the shores of the Gulf of Campeachy. It is now naturalised in St. Domingo, Jamaica, and other West Indian islands.

Characters.—The logs as imported are from 3 to 4 feet long, heavy, and blackish purple or red externally, brownish red internally. Transverse sections present a series of concentric circles, alternating in colour. The wood is heavier than water, sp. gr. 1.06, cleavage irregular. The chips have a reddish brown colour, frequently marked with a peculiar beetle-green lustre due to hæmatein. When chewed they tinge the saliva a brilliant dark pink colour. Taste sweet and astringent. The chips when warmed evolve an agreeable odour.

Composition.—Logwood contains a small amount of volatile oil; tannin; a fatty resinous body; and hæmatoxylin.

Hæmatoxylin, $C_{16}H_{14}O_6 \cdot 3H_2O$. One of the best methods for isolating this body is first to macerate the crushed chips in water containing sulphurous acid or a sulphite to prevent oxidation, and then to exhaust with ether which has been previously agitated with water, recovering the ether, and dissolving the residue in water containing sulphurous acid, from which it crystallises in colourless needles, containing 1 or 3 molecules of water. On exposure to air and light the crystals quickly darken in colour, and finally become red, owing to oxidation and conversion into hæmatein. On fusion with caustic potash it yields pyrogallol $C_6H_3(OH)_3$. With alkalis it produces a beautiful violet colour, and it readily reduces solutions of the salts of mercury, silver, and copper.

When dissolved in ammonia solution it forms a very dark-coloured liquor, containing hæmatein-ammonia, which, on the addition of acetic acid, precipitates hæmatein, $C_{16}H_{14}O_6 \cdot 3H_2O$. Hæmatein is sparingly soluble in ether,

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readily in alcohol, from which it deposits as a dark powder with a cantharis-green lustre. Its solution, treated with reducing agents, becomes decolorised, yielding hæmatoxylin.

Logwood readily parts with its colouring matter to boiling water, which on evaporation leaves the hard, brittle extract.

Adulteration.—Brazil Wood, obtained from *Cæsalpinia Brasiliensis* and other species, bears a strong resemblance to logwood. Brazil Wood contains a crystallisable colouring body, Brazilin, which gives red solutions instead of purple. On treatment with nitric acid it forms picric acid, and on boiling with peroxide of lead and water it forms a strong fluorescent solution.

Therapeutics.—Astringent in certain forms of diarrhœa.

Used in the preparation of Decoctum Hæmatoxyli and Extractum Hæmatoxyli.

No. 67. Tamarindus. Tamarind.

The preserved pulp of the fruit of *Tamarindus Indica*.

Habitat.—Indigenous throughout India and Africa. Naturalised in Brazil and Mexico.

Preparation.—The fully ripened fruits are collected, and the brittle outer shell (epicarp) removed. In India the inner portion is pressed into a mass, to which a certain amount of sugar has been added. In the West Indies the pulpy portion is packed in suitable vessels, and boiling syrup poured over the mass. In Egypt the pressed cakes are dried in the sun.

Characters and Tests.—A reddish-brown, moist, sugary mass, enclosing strong branched fibres, and brown shining seeds, each enclosed in a tough membranous coat (endocarp). Taste agreeable, refreshing, subacid. A piece of bright iron, left in contact with the pulp for an hour, should not exhibit any deposit of copper.

Composition.—Tamarinds contain citric, tartaric, and malic acids, principally combined with potassium. Acetic acid is sometimes found, most likely resulting in the

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fermentation of the sugary mass. The testa of the seeds contains tannin. The pulp also contains pectin and mucilaginous matter.

Therapeutics.—Used as a mild laxative, and to quench thirst in cases of fever.

No. 68. Senna Alexandrina. *Alexandrian Senna.*

The dried leaflets of *Cassia acutifolia* (*Cassia lanceolata*).

Habitat.—Upper Egypt, Nubia, Sennaar, and Kordofan.

Characters.—*Cassia acutifolia* is a low shrubby plant, about 2 to 3 feet high, with light-coloured erect or ascending branches. Leaves pari-pinnate, 4 or 5-jugate. Leaflets lanceolate, or oval-lanceolate, broad, unequal at the base, entire, thin, brittle, pale yellowish-green, and on the under surface very finely pubescent or nearly smooth. Odour peculiar, faint, tea-like; taste mucilaginous, nauseous, and sickly.

The leaflets of *Cassia obovata* are not now met with in commerce; although this species is found in Arabia as well as Upper Egypt.

Collection.—The collection of senna leaves commences towards the end of September, after the rainy season. The inhabitants of the district first cut down the branches and allow them to dry by exposure to the sun, after which the leaves are stripped off by picking or beating the branches with a stick, and are then packed in bags, and shipped down the Nile to Cairo or Alexandria.

Alexandrian Senna, as imported, is of very variable quality, containing leaf-stalks, flowers, pods, and broken branches, a considerable admixture of the leaves of *Solenostemma Argel*, besides seeds, stones and other rubbish; considerable care is therefore taken in sifting and picking this drug. The addition of impurities sometimes amounts to 60 per cent. of the weight of the drug.

The only adulteration commonly met with is *Solenostemma Argel* (*Asclepiadaceæ*.) This adulteration is only found in the Alexandrian variety of senna. The leaves have

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a strong resemblance to senna in shape, colour, and size, but differ by their thick and coriaceous texture, which renders the lateral veins almost indistinct; they are equal at the base, surface wrinkled, colour greyish-green, taste decidedly bitter.

Official Preparations.—Confectio Sennæ; Infusum Sennæ; Mistura Sennæ Composita; Pulvis Glycyrrhizæ Co.; Syrupus Sennæ; Tinctura Sennæ.

No. 69. Senna Indica. *East Indian Senna.*

Synonym:—Tinnivelly Senna.

The dried leaflets of *Cassia angustifolio* (*Cassia elongata*).

Habitat.—This plant is found growing wild in Arabia and in Northern India. It is largely cultivated at Tinnivelly in Southern India.

Characters.—From about 1 inch to 2 inches in length, lanceolate, acute, unequal-sided at the base, thin, entire, yellowish-green and smooth above, somewhat duller beneath, and glabrous or slightly pubescent. In odour and taste very similar to Alexandrian Senna.

This Senna is always met with of a much better quality than the Alexandrian. It is never submitted to adulteration, and great care is exercised in collecting it.

The Bombay, East Indian, or Arabian Senna is obtained from the same species, but is collected from the wild plant and with less care than the Tinnivelly Senna.

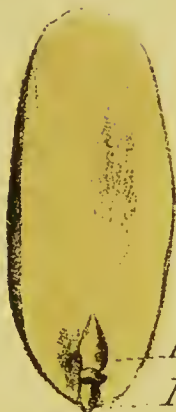
Composition of Senna.—Senna has yielded to different investigators a series of distinct principles, but it is only recently that the true active constituent of senna was isolated in the form of Cathartic acid, a body of complex composition, containing nitrogen and sulphur, and combined in the leaflets with magnesium and calcium, forming a colloid substance soluble in water and proof spirit, but not in strong alcohol.



N° 70



N° 81



Plumule
Radicule

Section.

N° 82



N° 83



N° 73



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Preparation.—Senna is bruised and thoroughly exhausted by percolation with warm water, the percolate is concentrated, and a small quantity of spirit is added to precipitate albuminous and mucilaginous matter. The liquid is then filtered, and to the filtrate alcohol is added until a precipitate ceases to be thrown down; this is then washed with alcohol, dissolved in water and reprecipitated by the addition of hydrochloric acid, and the precipitate purified by dissolving it in proof spirit and reprecipitating with ether; or it may be prepared by dialysis.

Cathartic acid is a yellowish-brown, amorphous powder, and on hydrolysis, yields Cathartogenic acid and glucose. Senna also contains small quantities of Cathartomannite, which is dextrogyrate.

A substance, supposed to be identical with Chrysophan, appears to be the principal colouring matter of senna.

Sennacrol and Sennapicrin, obtained by Ludwig, are resinous bodies, the former being soluble in ether, the latter insoluble.

Therapeutics.—Purgative.

No. 70. Cassiæ Pulpa. *Cassia Pulp.*

The pulp prepared from the recently imported legumes of Cassia Fistula (*Cathartocarpus Fistula*).

Habitat.—A tree of about 50 feet in height; found indigenous to India, but is now cultivated in Tropical Africa, Egypt, Brazil, and the West Indian Islands.

Characters.—The legumes are from 1 to $2\frac{1}{2}$ feet in length, and about 1 inch thick. The pericarp is woody, hard, of a blackish-brown colour, and indehiscent. The dorsal and ventral sutures are marked by two smooth longitudinal bands. Along the band of the dorsal suture there runs a fine ridge, while the ventral suture is marked by a shallow groove; internally the fruit is divided into a large number of loculi, by thin, transverse, spurious dissepiments (phragmata). Each loculus contains one seed, embedded in a blackish-brown sweet pulp, which has a sickly odour and viscid consistency. This seed, unlike those of most leguminous plants, is albuminous.

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Composition.—Cassia pulp contains a considerable amount of sugar, besides small quantities of acid tartrate of potassium, pectin, and gum.

Other Varieties.—The fruit of *Cassia moschata*, found growing in Surinam, Panama, and New Grenada, closely resembles the official fruit, but the pulp is somewhat bitter and astringent, and of a bright brown hue, and when crushed and warmed emits an odour not unlike sandal wood oil. The fruit of *Cassia Brasiliana* (*C. grandis*), indigenous to Central America, and sometimes called horse cassia, is much larger and coarser, and the ventral suture is marked by two prominent ridges, and the surface of the pod with prominent veins.

No. 71. Copaiba. *Copaiva* or *Copaiba*.

The oleo-resin obtained by cutting deeply or boring into the trunk of *Copaifera Langsdorffi* and other species, of which the following may be mentioned:—*Copaifera officinalis*, *C. Guianensis*, *C. coriacea*. The *Copaifera multijuga* is a doubtful species.

Habitat.—Throughout Tropical South America and in some of the West Indian Islands.

Secretion.—Copaiva is contained in large resin passages in the wood of the stem, and is not found in the bark. The resin passages are supposed to arise from the solution of the cell-wall of several contiguous cells, but nothing definite is known on this point.

Collection.—The Indian, having selected a tree, cuts a large hole into the trunk at or near the base, and into this cavity the oleo-resin flows, and is removed from time to time, and poured into large leather bottles, in which it is carried to the sea-coast. It frequently happens that there will be no flow of balsam on first cutting the tree; if such is the case the cavity is plastered over with clay or any other suitable material, which is allowed to remain for some time, and then removed, and the oleo-resin collected. By this latter process an abundant flow is obtained. Old trees

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yield the oleo-resin two or three times a season, and it frequently exudes at the rate of from 10 to 12 pounds in three hours.

In commerce there are two principal kinds of Copaiva, viz: Para and Maranhã; from these ports it is exported in barrels. Occasionally it is shipped from Carthagena, Rio de Janeiro, and Maracaibo, in which case it is named from the port of exportation.

Rio de Janeiro and Maranhã Copaiva are mainly obtained from *C. Langsdorffi* and *C. coriacea*. Para Copaiva from *C. Guianensis*. Carthagena and Maracaibo Copaiva principally from *C. officinalis*. The Maracaibo variety is seldom imported.

Characters.—A more or less clear and viscid liquid, generally transparent, in thin layers, but when examined in bulk it appears turbid or opalescent, and faintly fluorescent; colour, pale brownish-yellow or very light yellow; having a peculiar aromatic odour; taste, somewhat bitter, and persistently acrid and nauseous. Its specific gravity varies from .940 to .993, and on keeping it becomes denser and thicker. When heated for some time it loses its volatile oil (which should not have a terebinthinate odour), leaving a resinous residue, which, when cold, is hard and pulverizable, and entirely soluble in glacial acetic acid. It is soluble in absolute alcohol, and in four times its volume of rectified spirit; insoluble in water, but soluble in carbon disulphide, volatile and fatty oils, ether, acetone, and in four times its bulk of petroleum ether, which solution should only give a faint deposit of resin on standing.

Para Copaiva is the lightest and most limpid, yielding as much as 82 per cent. of volatile oil. Maranhã and Rio Copaiva are denser and more viscid, rarely containing more than 50 per cent. of volatile oil.

Maracaibo Copaiva is the most viscid, and generally of a darker colour. Two samples which were distilled yielded an average of 35 per cent. of volatile oil.

Composition.—Copaiva contains varying proportions of Volatile Oil, Copaivic Acid, Resins, and a bitter principle.

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Volatile Oil. This is readily obtained by distilling the oleo-resin with an equal volume of water, and then separating the oil from that portion of the water which distils over with it. Oil of Copaiva has a similar composition to terebinthene, being a polymer, or a mixture of two or more polymers of that body. It is soluble in absolute alcohol, and its solution is neutral to test paper. Specific gravity, .89 to .92: boiling point, 480° F. It is generally colourless, or of a very pale straw-yellow, but on keeping it darkens and becomes thicker. A commercial sample of Copaiva yielded 62 per cent. of volatile oil.

Copaiva Resin is a complex mixture containing a neutral resin, metacopaivic, oxycopaivic, and copaivic acids. It is an amorphous, hard, brittle substance, of a brownish-yellow colour, and strong acid taste. It is soluble in amyl alcohol, benzol, and absolute alcohol, the solution having an acid reaction.

Copaivic Acid, and the other resin-acids of copaiva, can be obtained by boiling the oleo-resin with solution of caustic soda, then separating the alkaline solution and precipitating the acid by addition of hydrochloric acid, collecting the precipitated acid and crystallising from alcohol. All three acids do not usually occur in one kind of copaiva. Metacopaivic Acid is the principal acid in Maracaibo oleo-resin.

The metacopaivic and copaivic acids of German commerce are largely prepared from the oleo-resin known as gurgun oil.

The bitter principle of copaiva is removed on boiling with water, concentrating the solution, and filtering. The filtrate has an intensely bitter taste and acid reaction, and yields a flocculent precipitate on the addition of solution of tannic acid.

Adulterations.—As copaiva has a variable composition, frequent advantage is taken of this to sophisticate the drug. Amongst the commoner additions, fatty oils, turpentine, and gurgun oleo-resin are met with, and more rarely the oleo-resin of *Hardwickia pinnata*.

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Fatty oils. The resin left after dissolving the oleo-resin in absolute alcohol, and carefully evaporating in an open dish until it ceases to lose weight, should be hard and brittle, transparent, and easily reduced to powder; if fatty oil be present the resin will be soft and plastic, and if oils other than castor oil be present the residual resin will give a turbid solution with absolute alcohol. Castor oil is readily detected by the tests given by Flückiger and Hanbury, namely, agitate the oleo-resin with four times its weight of alcohol, warm, and on cooling decant the clear superstratum, evaporate to expel the alcohol and volatile oil (a sand bath for this purpose is preferable), mix the residue with soda lime, and heat, when the peculiar characteristic odour of œnanthol is recognised.

Turpentine is readily recognised by slowly heating a portion of the oleo-resin, when it may be detected by its odour. The German Pharmacopœia gives the following test for turpentine, resin, and resin oil, but it does not always give satisfactory results:—1 part of copaiva mixed with 5 parts of water at 122° F., and well shaken, form a turbid mixture, which on warming in a water bath forms two clear layers.

Gurgun oleo-resin and the oleo-resin of *Hardwickia pinnata*. If Gurgun oleo-resin is present the fluorescence of copaiva will be increased in proportion to the amount added. The presence of this oleo-resin, and also that of *Hardwickia*, may be recognised by the following process:—Dissolve 1 drop of the balsam in 19 drops of carbon disulphide, and then add 1 drop of a mixture of equal parts of nitric and sulphuric acids. Pure copaiva acquires a reddish-brown colour, and deposits a resin. If Gurgun oleo-resin is present the mixture will assume a purplish-red colour, quickly changing to violet; and the oleo-resin of *Hardwickia* forms a green coloured solution. It is advisable to slightly warm the mixture after addition of the acids, and then add a little more carbon disulphide, when the colours are more easily observed.

The violet colour produced by the Gurgun oleo-resin is due to the volatile oil.

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Sub-Order Mimoseæ.

No. 72. *Acaciæ Gummi.* *Gum Acacia.*

A gummy exudation from the stem and branches of *Acacia Senegal* (A. Verek), and from other species, of which the following may be mentioned:—*A. vera* (Arabica, nilotica), *A. stenocarpa*, *A. tortilis*, and *A. Ehrenbergii*.

Habitat.—The above species of *Acacia* are trees or shrubs found growing in Nubia, Abyssinia, Egypt, Senegambia, Kordofan, and Arabia.

Formation.—Gum Arabic, and other gums which are regarded as degradation products of the plant, most probably result from some physico-chemical metamorphosis of the cell contents, or of the wall of the cell, or, as others have considered, from the transformation of the starch granules, the quantity being increased by some abnormal condition of the tree.

Collection.—The gum exudes spontaneously from the axils of the branches, and the flow is considerably augmented by making deep incisions into the wood; but this latter process is seldom resorted to. The exudation is most plentiful during the summer months. It exudes as a thick liquid, which quickly hardens on the bark, and frequently falls off, or it is removed by means of a blunt knife or wooden mallet. The finest qualities of gum come from the upper districts of the White Nile.

Characters.—In roundish, ovoid, or vermicular tears, or masses, of various sizes; or in angular fragments with glistening surfaces; colourless, or with a yellowish, brownish, or reddish tint. The tears are either opaque from numerous minute fissures and very brittle, or more or less transparent and not readily broken; the fractured surfaces are vitreous in appearance. Taste bland and mucilaginous; without odour; insoluble in alcohol, but entirely soluble in water and forming a clear mucilaginous solution. The aqueous solution forms with subacetate of lead an opaque white jelly. If an aqueous solution of iodine be added to the powder, or to a solution formed with boiling water and cooled, there is no appearance of a violet or blue colour.

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Composition.—Gum Arabic contains about 15 per cent. of water, the residue being a compound of calcium and gummic or arabic acid, containing also a little potassium, magnesium, and phosphoric acid. Arabic or gummic acid is best prepared from an aqueous solution of gum by adding hydrochloric acid to the solution and then pouring upon a dialyser, when it is left as a gelatinoid mass, or after the addition of the acid, alcohol may be added, which precipitates it; after which it is well washed with alcohol. Gummic acid is soluble in water, while still moist, after precipitation; but on drying and then adding water it merely swells up. It is soluble in lime water and solution of the alkalies; its solution in lime water, or as natural gum, gelatinises on the addition of a solution of a soluble borate or silicate and ferric chloride. By boiling with diluted sulphuric acid it yields a sugar (arabinose); on treatment with nitric acid it yields principally mucic and oxalic acids.

Pectic and metapectic acids are most likely modifications of gummic acid.

Gum, on incineration, leaves from 1·8 to 4 per cent. of ash, principally calcium carbonate.

The peculiar character that some varieties of gum arabic possess of merely swelling up or forming a ropy mucilage is not quite understood. By the prolonged action of heat such a mucilage in time becomes quite fluid; a temperature of 80° F. is best for this purpose.

Other varieties of gum.

1. Cape gum, produced from *Acacia horrida*, generally of an amber colour; brittle, and affording a weak mucilage.

2. Australian or Wattle gum, derived from *Acacia pycnantha*, *A. decurrens*, *A. dealbata*, and other species, is found in large tears of a reddish-brown colour, very tough, and breaks with a glassy fracture; it forms a strongly adhesive mucilage. Quite recently large quantities of this gum have been imported into this country.

3. Senegal gum, the product of *Acacia Adansonii* and other species. This gum is used principally in France. It occurs in yellowish or brownish-red lumps, or often in elongated tears.

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4. Talca gum is yielded by *Acacia stenocarpa* and *A. Seyal*; it is characterised by its extreme bitterness, and is frequently found in a half-powdered condition, consisting of a mixture of colourless and brownish-red tears.

5. Sennari gum, which is of a dirty white tint, yields a ropy mucilage.

The Barks of various species of *Acacias* are largely used in the Colonies for tanning purposes, many of them containing from 10 to 25 per cent. of tannin.

Used in the preparation of *Mistura Cretæ*, *Mistura Guaiaci*, *Mucilago Acaciæ*, *Pulvis Amygdalæ Co.*, *Pulvis Tragacanthæ Compositus*, and in the *Trochisci*.

No. 73. Catechu Nigrum. *Black Catechu, Cutch.*

An extract prepared principally from the heart-wood of *Acacia Catechu* and *Acacia Suma*.

Habitat.—Indigenous to the East Indies and Ceylon.

Manufacture.—The tree is cut down and chopped into small pieces. The chips are then placed in earthen jars arranged over a fireplace, and the jars filled with water and boiled for some time, the decoction being removed and more water added, and the boiling continued until the wood is exhausted; the decoction is now strained into a large earthen pot and evaporated down until it is sufficiently thick, it is then poured into clay moulds or into hollows covered with the large leaves of *Dipterocarpus tuberculatus*. After hardening, it is packed in boxes for shipping. It is principally imported from Pegu, in Lower Burmah, and Calcutta.

A form of catechu has been imported lately in square thin pieces, about 4 inches long and $2\frac{1}{2}$ inches broad. It is said to contain a higher percentage of catechu-tannic acid.

Characters.—Cutch as imported is in large dark-brown masses, which are generally soft in the interior, but on drying it becomes hard and brittle; it breaks with an irregular, slightly porous, and granular fracture. It is almost entirely soluble in alcohol, with a slightly sweet but strong astringent taste. When carefully examined under

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the microscope, having previously moistened the powder with glycerine, it is seen to have a marked crystalline appearance. Occasionally it is imported in small round cakes, some varieties of which resemble lozenges, or in parallelograms technically known as "strips."

Composition.—Cutch contains Catechin, Catechu-tannic acid, and Quercetin.

Catechin or Catechuic acid is that portion of cutch which is left insoluble after continuous treatment with water; it is purified by solution in alcohol, precipitating any tannin left by addition of plumbic acetate as long as a dark coloured precipitate is thrown down, then filtering the alcoholic solution through animal charcoal, and allowing it to stand, when the acid is deposited in fine silky needles. It strikes a green colour with ferric salts, and its solution, agitated with reduced iron, produces a violet colour. On dry distillation it yields pyrocatechin $C_6H_4(OH)_2$, and on fusion with caustic potash it yields phloroglucin and protocatechuic acid; this is a common reaction with numerous tannins and resins; when heated to 320° F. for some time, it is converted into its anhydride, catechu-tannic acid.

Catechu-tannic acid is readily extracted by heating with warm water, and is the principal constituent of the brown solution.

Quercetin. This body is best removed by macerating powdered and well-dried cutch in anhydrous ether, decanting the ethereal solution, and evaporating, when it is left as a yellow amorphous substance. It is present only in very small proportion.

Impurities.—Cutch is frequently intermixed with broken twigs and leaves, which are best seen on breaking a sample.

ROSACEÆ.**No. 74. Rosæ Centifoliæ Petala. Cabbage Rose Petals.**

The fresh fully expanded petals of *Rosa centifolia*.

Habitat.—Indigenous to Western Asia, largely cultivated in European countries. In England it is cultivated at Mitcham.

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Characters.—The flowers are collected when full-blown, and the calyx and ovaries carefully removed. The petals are large, thin, and delicate, with a retuse apex, nearly obovate; colour when fresh a pale pink, changing to light brown on keeping; odour fragrant and agreeable; taste slightly sweet and astringent, and faintly bitter.

Composition. — In composition the petals are almost identical with those of red rose. On distillation with water they yield a small quantity of an agreeable essential oil, and the aqueous distillate, after removal of the oil, retains the fragrant odour and sweetish taste of the petals.

Oleum Rosæ. *Oil of Rose, Otto (Attar) of Roses.*

The volatile oil distilled from the fresh flowers of *Rosa damascena*, and occasionally from other species.

Habitat. — Roses are largely cultivated throughout Southern and Eastern Europe, India, and Northern Africa, for the preparation of rose-water and otto.

Production.—The bulk of the otto of rose of commerce is imported from the Turkish provinces in Europe, being largely produced in Roumelia, Bulgaria, and throughout the Balkan Principalities, Kizanlik being the principal dépôt. The shrubs are generally cultivated in rows, and the flowers collected early in the morning, and distilled the same day. The process of distillation is carried on in primitive copper stills, and the oil, as it swims on the surface of the distillate, is removed by a funnel-shaped tin vessel, or the distillate is redistilled, and the first sixth that distils over removed and the oil separated. Otto of Roses, as generally imported from Constantinople, is contained in elaborate gilt bottles; more recently considerable quantities have been met with in kunkumas or flattened round tinned copper flasks, containing from 1 lb. to 12 lbs. of oil; the flasks are covered with a thick woollen fabric bearing numerous seals. During the last two or three years otto has been imported in quantity from the south of France, of very good quality.

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Characters.—Otto of Rose is of a pale yellow colour, transparent, but when the temperature is gradually lowered it solidifies into a semi-transparent mass, consisting of light brilliant scale-like crystals which, on rapid cooling, crystallise in the form of feathery prisms. As the solid stearoptene of the oil varies considerably in amount in different samples of genuine otto, being in larger proportion in oil derived from the mountain districts than in that from the lowlands, there is a necessary variation in their melting points; the average of six samples examined gave a mean of 57° F., the lowest being 53·2° F., and the highest 61° F. Its specific gravity varies from ·87 to ·89. The inodorous stearoptene is insoluble in alcohol ·838; but the otto is entirely soluble in absolute alcohol (Baur). The otto possesses the fragrant and delicious odour of the petals in a high degree.

Composition.—Otto of Rose consists of an elæoptene or fluid oil, which is an oxygenated body, to which it entirely owes its perfume; it is readily soluble in spirit; and a stearoptene or solid hydrocarbon, which is inodorous. The latter is best isolated by dissolving the otto in ether and adding an equal bulk of rectified spirit, when it is precipitated; it can be purified by re-solution in ether or chloroform, and re-precipitation with alcohol. It occurs in iridescent, platy crystals; when heated it evolves the disagreeable odour of warm fat.

Adulterations.—Otto of Rose is extensively adulterated, and amongst the more commonly occurring substitutes are Turkish oil of geranium, or oil of gingergrass, prepared in India from *Andropogon Schænanthus*; this oil is generally bleached prior to use; oil of rose geranium distilled from *Pelargonium roseum*; and oil of rhodium obtained from the root of *Convolvulus scoparius* and other species; this oil has a pungent bitter taste. All of these oils have a marked acid reaction, true otto being neutral. When oil of rose geranium is boiled with salicylic acid, and the hot fluid decanted, on cooling it crystallises not unlike otto; and quite recently a sample was examined which consisted entirely of this oil. Fatty oils, such as almond oil, are frequently added to otto to keep it permanently fluid.

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Test.—A sample of good otto should congeal in five minutes when exposed to a temperature of 55° F. (Baur). When 1 part of otto is dissolved in 5 parts of chloroform, and 20 parts of spirit added, the mixture should deposit crystalline scales which are neutral to litmus.

No. 75. Rosæ Gallicæ Petala. Red Rose Petals.

The fresh and dried unexpanded petals of *Rosa gallica*.

Habitat.—Indigenous to the Levant and Southern Europe. Cultivated on a large scale at Wassenaar and Noordwijk in the Netherlands, at Mitcham and other districts in England; also in Germany and France.

Characters.—Usually in small, cone-like masses, sometimes separate and more or less crumpled; when opened out the petals are roundish, with a retuse apex, and a short yellow claw; fine purplish red, which does not fade on drying and keeping, velvety in aspect; odour fragrant, roseate; taste somewhat bitter, slightly acid and astringent.

Collection.—Red Rose petals are generally gathered while the flower is still unexpanded; they are carefully snipped off by means of scissors, leaving the short claw attached to the calyx; they are then immediately dried by means of a warm stove, and afterwards gently shaken in sieves to free them from adhering stamens.

Composition.—Red Rose petals contain a characteristic colouring matter, quercitrin, gallic acid, sugar, and fat.

The red colouring matter is removed by first percolating the petals with ether, which removes quercitrin and fat, and then macerating with alcohol; it is precipitated from its alcoholic solution by basic lead acetate. The red colour is intensified by the addition of dilute sulphuric acid, and forms a green fluorescent solution with alkalies. Quercitrin is left in the residue after evaporating off the ether; it gives a dark green colour with ferric salts. When the petals are treated with boiling water a small quantity of the colouring matter is removed, together with the gallic acid. The astringency of the petals is due to the quercitrin.

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Quercitrin has recently been proved to be closely allied to rutin, both yielding quercetin and isodulcite, the former yielding most quercetin. (Schunck.)

Adulteration.—About five years ago a considerable amount of artificially coloured rose petals was shipped to London from Hamburg, but the fraud was soon recognised. The petals were coloured with a solution of rosaniline, and when treated with proof spirit gave a deep crimson solution. The rosaniline can be readily recognised by the following test:—A tincture of the petals is made in proof spirit, and a portion rendered alkaline by ammonia, then a small plug of cotton wool added, and the whole boiled for a short time. The wool becomes dyed, and is taken out and digested in a weak solution of caustic potash, to the solution is added an equal volume of alcohol, and then twice its volume of ether, and agitated, the ethereal layer removed, and on adding acetic acid a bright pink colour of rosaniline acetate is produced.

Used in the preparation of *Confectio Rosæ Gallicæ*, *Infusum Rosæ Acidum*, and *Syrupus Rosæ Gallicæ*.

No. 76. Rosæ Caninæ Fructus.

Fruit of the Dog Rose. Hips.

The ripe fruits of *Rosa canina* and other indigenous allied species.

Habitat.—Indigenous.

Characters.—The fruit (a cynarrhodum) is about three-quarters of an inch or more in length, and consists of an enlarged and succulent calyx tube, ovoid or somewhat oval, smooth, shining, scarlet or red, and containing inside a large number of seed-like fruits (achenes), which are covered with minute hairs. Inodorous and fleshy; taste agreeable, sweetish, and acidulous.

Composition.—The pulp when examined by Biltz yielded 2.95 per cent. of citric acid, 7.7 per cent. of malic acid, 30.5 per cent. of sugar, 25 per cent. of gum, and traces of resin, and salts of malic and citric acids.

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Used in the preparation of Confectio Rosæ Caninæ (Confectio Cynosbati).

No. 77. Tormentillæ Rhizoma. Tormentil.

(*Not official.*)

The dried rhizome of *Potentilla Tormentilla*.

Habitat.—Indigenous to Europe and Northern Asia.

Characters.—The rhizome is generally from two to three inches long, irregularly cylindrical, and sometimes divided, thick, and externally marked by numerous protuberances: externally of a reddish-brown colour, internally generally of a deeper tint; fracture brittle and slightly resinous; inodorous; taste persistently astringent.

Composition.—Tormentil contains nearly 30 per cent. of tormentil-tannic acid, and about 20 per cent. of tormentil red, closely allied to rhatany-red; it also contains small quantities of kinovic and ellagic acids, resin, and mucilage.

Therapeutics.—Astringent.

No. 78. Cusso. Kousso.

The dried panicles (principally of the female flowers) of *Hagenia Abyssinica* (*Brayera anthelmintica*).

Habitat.—A large tree found in the mountainous districts of Abyssinia.

Characters.—The flowers occur in long panicles, and are unisexual; and although both female and male (monœcious) occur in the same tree, the former is chiefly collected. Kousso occurs in compressed clusters, or more or less cylindrical rolls, about one foot in length, or the panicles are broken into small fragments, varying in colour from brown, greenish-brown, to reddish in the female flowers. Odour herby, tea-like; taste bitter, acrid, and disagreeable. The separate panicles are much branched, and zigzag; generally covered with hairs and glands, and at the base of each branch there is a large sheathing bract. Flowers numerous, small, unisexual, with a membranous bract at the base of each flower. The calyx is hairy externally.

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Red Kousso consists entirely of female flowers; it is chiefly imported by way of Aden and Bombay.

Composition.—Kousso contains a peculiar resinous principle, called Koussin, or Brayerin, which when purified forms fine crystals; about 25 per cent. of tannin, also wax, gum, and sugar.

The tannin is said to be composed of two distinct varieties, but belongs to the class that gives a green colour with ferric chloride.

Koussin, $C_{31}H_{38}O_{10}$. The resinous principle of the plant is generally extracted by mixing the flowers with lime, and then exhausting with alcohol, and afterwards with water, mixing the solutions, concentrating and adding acetic acid, when the koussin is deposited. It is readily soluble in chloroform, ether, benzol, and boiling alcohol, from which it crystallises on cooling in yellow needles or prisms, melting at 287° F. It is partially decomposed by sulphuric acid, giving off the odour of butyric acid, and its solution after a time becomes bright red. Koussin is usually regarded as belonging to a class of organic acids of which santonin is the type. The resin of kousso amounts to 10 per cent., and is readily saponified with caustic soda or potash.

Therapeutics.—Anthelmintic.

Dose— $\frac{1}{4}$ to $\frac{1}{2}$ ounce.

Official Preparation.—Infusum Cusso.

No. 79. Cortex Pruni Serotinæ. Wild Cherry Bark.

(*Not official.*)

The bark of *Prunus serotina* from which the outer suberous layer has been removed.

Habitat.—A large tree growing throughout the North American Continent, generally about 60 feet high.

Characters.—The bark is collected from the trunk and branches, and occasionally from the root. As met with it occurs in irregular, flat, or channelled pieces, varying from $\frac{1}{2}$ to 2 inches broad, and about 6 inches long; the smaller

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and thinner pieces are obtained from the branches; they are frequently covered with a thin papery external covering, marked with numerous scars, and the surface is smooth and shining. The inner surface is finely striated, and of a reddish or cinnamon-brown colour. In the older pieces, from which the suberous layer has been removed, generally by shaving, it is somewhat irregular and rough, and of a rusty brown colour. The bark breaks with a brittle and granular fracture. It has little or no odour when dry, but on macerating in cold water for a time it develops the odour of the volatile oil of bitter almonds. Taste aromatic, bitter, and astringent, followed by that of bitter almonds.

From quantitative examinations of this bark, collected at different seasons of the year, it was found that the bark collected during October and November yielded the largest amount of hydrocyanic acid, and that the bark of the younger branches is the best.

Composition.—Wild Cherry bark contains a bitter principle, amygdalin, and a proteinaceous body resembling emulsin.

The bitter principle, which is closely related to phlorrhizin, is extracted by aqueous infusion, from which it can be removed by adding alcohol and slaked lime, agitating, and filtering, evaporating the filtrate and exhausting with strong alcohol, and carefully evaporating on a water bath. It is an amorphous substance, with a pronounced bitter taste, and with strong sulphuric acid gives a red colour. It is readily soluble in water, but insoluble in chloroform or ether.

Amygdalin, $C_{20}H_{27}NO_{11}, 3H_2O$. The amount of this glucoside present in the bark varies within wide limits, and can be extracted by treating the bark with boiling alcohol, from which solution, on evaporation, it is deposited in crystalline laminae possessing a bitter taste.

The proteid body, resembling emulsin, is readily soluble in water, and when the bark is macerated in cold water this body completely decomposes the amygdalin, resolving it into glucose, hydrocyanic acid, and benzylic aldehyd (essential oil of bitter almonds), thus: — $C_{20}H_{27}NO_{11} +$

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$3\text{H}_2\text{O} = \text{C}_6\text{H}_5\text{C OH} + 2\text{C}_6\text{H}_{12}\text{O}_6 + \text{HCN} + \text{H}_2\text{O}$. A good sample of young bark yielded .14 per cent. of anhydrous hydrocyanic acid. The bark also contains a little gallic acid, resin, and about 4 per cent. of a tannin.

Substitute.—The bark of this species has been frequently mistaken for that obtained from the *Prunus Virginiana*. The choke cherry is also indigenous to the North American forests. This is a shrubby plant, rarely exceeding ten feet in height. The bark and leaves, like those of the wild cherry, yield hydrocyanic acid.

No. 80. Fructus Pruni. Prunes.

The dried drupe of *Prunus domestica*, var. *Juliana*.

Habitat.—The plum tree is indigenous to Western Asia, particularly the shores of the Black Sea, and Northern Persia; it is also found wild in Greece. The medicinal prunes obtained from the above variety are principally cultivated in France, in the Loire district.

Characters.—The dried drupe is ovoid or oblong, about $1\frac{1}{4}$ inch long; of a black or dark purple colour; glaucous, shrivelled, and has a longitudinal furrow. The sarcocarp is brownish, without marked odour; and the putamen smooth, slightly flattened, hard, and oblong; ridges irregular. The sarcocarp, which is the portion used in medicine, has a sweetish sub-acid agreeable taste. The seeds, when removed and submitted to pressure, yield 20 per cent. of a bland yellow oil.

Composition.—The pulp contains a considerable amount of sugar, mucilaginous matter, pectin, malic acid, and albuminoid substance. The proportion of sugar varies from 14 to 34 per cent. of the weight of the fruit.

Substitutes.—As there are different varieties of *Prunus domestica*, their fruits are collected; the German prune has a much thicker epicarp, and the fruit is more elongated.

*Rosaceæ.***No. 81. Amygdala Amara.** *Bitter Almond.*

The ripe seed of the Bitter Almond Tree, *Prunus Amygdalus*, var. *amara* (*Amygdalus communis*, var. *amara*).

Habitat.—The almond tree is found growing throughout Asia Minor and Persia ; but its true habitat has never been thoroughly ascertained. It is cultivated in Southern Europe ; also in Algeria, and other North African countries.

Characters.—There is no permanent character by which the bitter almond tree can be distinguished from the sweet almond, except in one of the constituents of the seed. The fruit is a drupe, ovate in form, and from 1 to 2 inches long, and about $1\frac{1}{2}$ inch broad, with a velvety sarcocarp, which is of a white colour, and which splits at maturity, and then falls off, leaving naked, and still attached to the stalk, the putamen, containing the seed which constitutes the commercial almond. The putamen is oblong, ovate and pitted with irregular holes ; it is brittle, and breaks easily, exposing the elongated seed.

The seed is covered with a cinnamon brown scurfy testa, pointed at its upper end, and rounded at the other extremity, presenting a blunt appearance, the testa firmly adherent to the pale coloured tegmen, both of which are easily removed on macerating the seeds in water, leaving the white embryo. The hilum is found at the pointed end, and situated on the edge of the almond, from which runs the raphe, terminating at the rounded end in the chalaza, which divides into a number of fine lines running towards the pointed upper end. The seed is composed of two cotyledons, which are aperispermic, white and oily ; between the cotyledons, and situated at the pointed and basal end, is seen the small plumule and radicle, the latter slightly projecting. Bitter almonds are inodorous, but when chewed have a bland nutty flavour, quickly changing to a bitter taste, and a flavour resembling that of ratafia or peach kernels.

Bitter almonds are also distinguished from sweet almonds by being more frequently angular, from the mutual pressure of two occurring in the same putamen.

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Varieties.—There are several commercial varieties of bitter almonds, generally distinguished by the name of the country from which they are imported, namely, French, Sicilian, and Barbary.

Composition.—Bitter almonds contain from 45 to 50 per cent. of fixed oil, of which 43 per cent. can be obtained by expression; and about 7 per cent. of cane sugar. They also contain two proteinaceous substances, Amandin, Emulsin or Synaptase, and a characteristic glucoside, Amygdalin. The testa contains tannin, resin, and a bitter acrid principle which is coloured bright red by caustic potash.

Amandin and Emulsin. These proteinaceous bodies are extracted from the bitter almond cake after removal of the oil by expression, and the amygdalin by alcohol; the residual cake is macerated in cold water, and then filtered, the filtrate carefully evaporated to one-third its original volume, and acetic acid added, which precipitates the amandin. This is collected on a filter, washed with water containing a little acetic acid, and then carefully dried. To the filtrate containing the emulsin, alcohol is added, and the precipitated emulsin is collected. Both these so-called vegetable ferments seem to possess a selective affinity for certain glucosides, readily hydrolising them in the presence of water; but what change they undergo themselves is not quite understood. Emulsin seems to be the principal agent in decomposing the amygdalin and in emulsifying the fatty oil.

Amygdalin, $C_{20}H_{27}NO_{11} \cdot 3H_2O$. This crystalline body is best prepared from the seeds after they have been freed from the fatty oil by exhausting with boiling alcohol, filtering, and allowing the liquid to stand, when it crystallises in prisms. It is afterwards purified by washing with ether and recrystallising from boiling alcohol. It is soluble in water, and crystallises from its aqueous solution in pearly scales, and from its alcoholic solution in fine prisms. On prolonged boiling with baryta water it decomposes into ammonia and amygdalic acid, $C_{20}H_{28}O_{13}$; this reaction is adopted as a process for its estimation (Rieckher); the amygdalic acid can be obtained by precipitation with mineral acids. It is decomposed by

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albuminous ferments into glucose, hydrocyanic acid, and essential oil of bitter almonds (benzaldehyd). Bitter almonds yield about 3 per cent. of amygdalin. Many other drupaceous fruits contain seeds which yield amygdalin, particularly those of plants belonging to the Pomeæ and Amygdaleæ.

Essential Oil of Bitter Almonds, Benzaldehyd, $C_6H_5C OH$. The bitter almond cake, after expression of the fatty oil, is broken up and macerated with five or six times its weight of water, at a temperature of $120^{\circ} F.$, for about twenty-four hours; too high a temperature must be avoided, or the albuminoid ferments will become coagulated, and cease to act. Simple distillation over a naked fire is extremely difficult, on account of bumping; hence it is now distilled by a current of superheated steam, the distillate cooled, and the oil removed; the aqueous portion is frequently fractionated to recover dissolved oil. The yield of essential oil is very variable, due to the different kinds of almonds, but ranges from .8 to 2.8 per cent.

Essential Oil of Bitter Almonds is a colourless liquid, with an aromatic odour, and an acrid, burning taste, and when freshly prepared smells strongly of hydrocyanic acid. Specific gravity, 1.06, and when freed from acid, 1.049. It is readily soluble in ether and alcohol. The oil, when first prepared, always contains variable quantities of hydrocyanic acid, and when freed from it consists entirely of pure benzaldehyd. It has recently been shown that a portion at least of the hydrocyanic acid is combined with the benzaldehyd; thus $C_6H_5 CH OH CN$ (Fileti and Volkel).

Purification of the oil. Various processes have been used in removing the hydrocyanic acid; such as solution of sodium acid sulphite, freshly precipitated mercuric oxide, and a mixture of ferrous sulphate and slaked lime; the latter is the method generally employed. The ferrous sulphate and slaked lime are intimately mixed, and placed in the still, then the oil is added, and the whole stirred, and left to stand some time, and finally distilled with superheated steam (Eck), and the oil collected. This method occasions a loss of about 10 per cent., and the oil afterwards is very

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prone to oxidation, being converted into benzoic acid. Large quantities of this oil are now prepared artificially from toluene. It is usually of a lighter colour than the natural oil.

Adulteration. The volatile oil is frequently liable to adulteration with nitrobenzol or oil of mirbane, alcohol, and chloroform. The two latter can be detected by distilling at a low temperature, when they will pass over, leaving the oil. Various methods can be used for the detection of nitrobenzol; the following two give good results: add a drop or two of the oil to a solution of potassio-stannous chloride, and afterwards a drop of carboic acid, and finally a little solution of chlorinated soda, when the blue colour of sodium erythrophenylate is produced (Jacquemin), or dissolve the oil in alcohol, and then add some hydrochloric acid and a few strips of zinc; after the action ceases add one third its volume of ether and agitate, decant the ethereal layer, allow it to evaporate, then add a little solution of chlorinated lime, when a purplish blue colour will appear (Hoffman).

If a large quantity of benzoic acid is present agitate the oil with a weak solution of potassium hydrate, and then add hydrochloric acid to the aqueous portion, when a flocculent precipitate is thrown out. A good oil, after keeping for some time, ought only to give a faint cloudiness when treated in this way.

Official Preparation.—Oleum Amygdalæ.

No. 82. Amygdala Dulcis. *Sweet Almonds.*

The ripe seed of the sweet almond tree, *Prunus Amygdalus*, var. *dulcis* (*Amygdalus communis*, var. *dulcis*).

Habitat.—Similar to the Bitter Almond tree.

Varieties.—They are largely cultivated in the Balearic Isles, and are principally exported *viâ* Valencia and Italian and French ports. The cultivation in Spain is carried on to a considerable extent; and the best almonds are exported from Malaga and known as Jordan almonds.

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This variety is particularly ordered in the Pharmacopœia; the putamen of this variety is hard and brittle. The soft-shelled almonds are mainly obtained from *Prunus Amygdalus*, var. *fragilis*. The commercial names for the varieties are Jordan, Valencia, Sicilian, and Barbary.

Characters.—Sweet Almonds are botanically identical with the bitter, but differ in generally being longer and narrower, with a sweet, bland, nutty flavour, which does not become bitter, and the white emulsion does not acquire any marked odour on standing.

Composition.—Sweet Almonds possess qualitatively the same composition as the bitter, with the exception that they contain no amygdalin and a relatively larger proportion of fixed oil, viz. 56 per cent.

Almond Oil is obtained from both bitter and sweet almonds. They are first agitated to remove adhering dust, then crushed and placed in canvas bags and submitted to pressure by the hydraulic press, when 50 per cent. of oil is obtained; frequently they are pressed between warm steel plates, but a lower yield of oil is obtained in this way. The oil is of a pale straw-yellow colour, thin and nearly inodorous, with a bland oleaginous nutty taste; soluble in ether, benzine, and chloroform. On exposure to the air it rapidly changes, turns rancid, and the odour becomes rank and disagreeable. It is nearly pure olein, with a minute quantity of palmitin, and is closely related to olive oil.

Colour Reactions of Almond Oil.

Fuming Nitric Acid 3 parts and water 2 parts	}	Form a white emulsion, and after standing 4 hours a solid white mass.
Calcium Bisulphide		White emulsion.
Sulphuric Acid sp.gr. 1.475 and potassium bichromate	}	Dark green, changing to brown.
Acid Solution of Mercury nitrate	}	White emulsion, changing to palish green on standing.
Strong Sulphuric Acid, 3 drops to 10 drops of oil, agitate	}	Yellow, changing to pale brownish yellow.

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Almond Oil is frequently the subject of adulteration, amongst the principal additions being apricot, ground-nut, cotton seed, peach and castor oils. They are all affected more or less by the above reagents, and any alteration in colour will be due to foreign oils. Castor oil can also be detected by the fact that when the oil is agitated with solution of ammonia it will form an imperfect emulsion if castor oil is present, the latter oil separating in drops ; and it can also be removed by agitation with alcohol, and treated with soda lime for the cœnanthol reaction.

Amandin and Emulsin.—These proteinaceous bodies are viewed by Rittenhausen and others as being modifications of the same substance, namely, vegetable casein.

When the almonds are crushed and macerated for some time in tepid water, and then distilled, the distillate will be found to contain a small quantity of hydrocyanic acid. On incineration almonds leave from 4 to 5 per cent. of ash, consisting of phosphates of calcium and magnesium.

The Sugar contained in sweet almonds consists entirely of glucose (Lehmann).

Official Preparations.—Oleum Amygdalæ, and Pulvis Amygdalæ Compositus.

No. 83. Lauro-cerasi Folia. *Cherry-Laurel Leaves.*

The fresh leaves of *Prunus Lauro-cerasus*.

Habitat.—Persia and Asia Minor, naturalised in Southern Europe and cultivated in England as an ornamental shrub.

Characters.—The leaves are thick, coriaceous, glossy, on strong short petioles, oblong or slightly obovate, 5 to 7 in. long, and tapering towards the extremities ; apex recurved, revolute at the margins, which are distinctly and sharply serrated, dark green above, paler beneath, with a prominent midrib, on either side of which, near the base, are two to four glandular depressions. The fresh leaves unbroken are inodorous, but on bruising develop a ratafia-like odour ; taste slightly astringent, aromatic and bitter. The best time to collect the leaves is during July and August.

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Composition.—Cherry-Laurel leaves contain a principle closely related to amygdalin, which is called lauro-cerasin; they also contain emulsin, malic acid, tannin, and wax.

Lauro-cerasin is obtained from the leaves by exhausting them with alcohol, freeing from colouring matter by oxide of lead, and then precipitating with ether. It has not yet been obtained in a crystalline form, and differs from amygdalin in having half of the cyanogen group converted into formic acid, so that it may be regarded as amygdalate of amygdalin, hence on decomposition with emulsin it yields less hydrocyanic acid than amygdalin. It is soluble in strong sulphuric acid, giving a reddish-violet colour. The leaves also contain a small quantity of an acid, called phyllinic acid.

When the leaves are chopped fine and macerated in water and then distilled, the distillate contains the volatile oil of bitter almonds and hydrocyanic acid; the official preparation is supposed to contain .1 per cent. of the latter; from a number of samples examined the highest percentage obtained was .075, and the lowest .036; it is an extremely unstable preparation.

It is said that the buds and very young leaves yield nearly ten times more oil and acid on distillation than the mature leaves.

Therapeutics.—The same as Hydrocyanic acid.

Official Preparation.—Aqua Lauro-cerasi.

No. 84. Semen Cydoniæ. Quince Seed or Pip.

(*Not official.*)

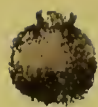
The dried seed of *Cydonia vulgaris* (*Pyrus Cydonia*).

Habitat.—Indigenous to Asia Minor and Persia, naturalized in the countries bordering on the Mediterranean Sea; cultivated in America.

Characters.—The fruit, which is sub-globular, or pyriform, has a golden-yellow colour and powerful odour, with a strong astringent taste while unripe. Botanically it differs from an apple in having numerous seeds arranged in two rows in each



N^o 85.



N^o 86.



N^o 91.



N^o 93.



N^o 104.

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loculus, an apple having only two seeds in each. Quince Seeds are oval or oblong in form, and by mutual pressure flattened and three-sided; the hilum is at the lower pointed end, from which the raphe runs as a straight ridge to the other end; the testa is of a mahogany-brown colour, covered with a mucilaginous epithelium. The kernels when bruised and steeped in water evolve the odour of hydrocyanic acid.

Composition.—Quince Seeds when thoroughly exhausted with water yield nearly 20 per cent. of dry mucilage, and one part of seeds will readily gelatinise thirty parts of water. The mucilage is only slightly adhesive, and is not affected by a solution of borax; it has a composition of $C_{18} H_{28} O_{14}$, and is precipitated from its solution by alcohol. It is generally regarded as a soluble modification of cellulose.

Therapeutics.—The pulp and rind possess an astringent character, and are used in cases of hæmorrhage.

MYRTACEÆ.**No. 85. Caryophyllum. Clove.**

The dried unexpanded flower-bud of *Eugenia caryophyllata* (*Caryophyllus aromaticus*).

Habitat.—The Clove tree is strictly indigenous to the Molucca Islands, but is now almost destroyed in those districts. It is largely cultivated in the East Indian Islands, Zanzibar, South America and the West Indies.

Collection.—As soon as the flower-buds of the corymbose inflorescence alter in colour from green to brownish-red, the branches are beaten with sticks, when the buds, from the peculiar jointed character of the short stalks supporting them, fall off, or the flower-buds are carefully picked by hand; this latter method being the one adopted in Zanzibar. The cloves are then spread out on sheets or bamboo trays, and dried by exposure to the sun. They are collected twice a year, in the months of June and December. The best cloves are imported from Zanzibar and the Moluccas.

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Characters.—The flower-bud of the clove tree consists of an elongated, nearly cylindrical calyx, solid, of a reddish-brown colour, and somewhat wrinkled, divided at the top into four limbs clasping the imbricate corolla, which forms a rounded head of a lighter colour, enclosing numerous stamens arranged in four bundles. The ovary is situated near the top of the calyx-tube and is two-celled, and contains numerous ovules, the style projecting upwards as a fine point. The clove varies from half to three-quarters of an inch in length; odour strong and fragrant; taste, aromatic, warm and pungent. When indented with the finger-nail it emits minute drops of oil; the oil is contained in irregular circles of oil-ducts or cells, which are situated just beneath the epidermis of the calyx.

Caryophyllin, $C_{20}H_{32}O$, is best obtained by collecting the cloves after the distillation of the essential oil, drying them, and then exhausting them with ether, recovering most of the ether by distillation, and allowing the residue to spontaneously evaporate, when it crystallises in needles. The crystalline deposit found in strong tincture of cloves is principally caryophyllin. The crystals, when pure, are colourless and tasteless, readily soluble in ether, dissolving in strong sulphuric acid with a dark red colour. When warmed with nitric acid they yield caryophyllinic acid, $C_{20}H_{32}O_6$ (Mylius).

Eugenin, $C_{10}H_{12}O_2$. This volatile body is obtained from the aqueous distillate after removal of the volatile oil; it separates on standing for some time in crystalline laminæ, possessing a faint odour of the clove (Bonastre).

The volatile oil is generally obtained by distilling with superheated steam, the cloves being first well bruised; or they may be distilled with water to which salt has been added to increase the boiling point. The oil is almost colourless, or of a pale straw colour; on keeping it darkens and becomes more viscid, possessing in a marked degree the odour and taste of the clove; it sinks in water, the specific gravity varying from 1.035 to 1.055. It is soluble in alcohol, and the solution gives a purple colour on the addition of ferric chloride. The oil is composed of two

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bodies, which are best separated by adding caustic potash solution to the oil, agitating and distilling, when the light neutral oil distils over, which has a slightly terebinthinate odour. On adding dilute sulphuric acid to the alkaline residue and again distilling, the heavy oil distils over, consisting entirely of Eugenol or Eugenic acid, $C_{10}H_{12}O_2$; it has a strong odour of cloves, and on oxidation with potassium bichromate and sulphuric acid yields Vanillin; it gives a purplish-blue colour with ferric chloride. Oil of cloves also contains minute quantities of salicylic acid as an ethereal compound; it can be removed from the oil by agitating with solution of ammonium carbonate. Cloves yield from 14 to 20 per cent. of volatile oil, of which eugenol comprises about 70 per cent. The oil is also obtained from the clove stalks, which yield about 5 per cent.

Adulterations.—Cloves. Occasionally cloves are submitted to adulteration, and for this purpose cloves from which the volatile oil has been removed are used. They are easily recognized by being soft and moist, the globular corolla being usually absent; they also have a very faint odour, and no sharp pungent taste. Clove stalks are sometimes found in samples of cloves, the result of careless picking; they are slightly branched, and of a light colour, and possess the characteristic clove odour and taste. The inferior fruit or berries known as mother cloves are occasionally met with in commerce; they are covered with the persistent calyx, and usually contain two or three seeds, and are about 1-in. in length. They also, like all parts of the clove tree, possess a pungent and aromatic taste.

Oil of Cloves. Amongst the adulterants used may be mentioned alcohol, phenol, copaiva, and oil of turpentine. On agitating equal volumes of oil and warm glycerine, and then allowing to stand until cold, any increase in the volume of the glycerine would indicate alcohol or phenol. When the oil is agitated with a little fuchsine it ought to remain colourless; if it becomes coloured alcohol is present. On agitating the oil with water the aqueous portion should not have an acid reaction, nor, on the addition of solution

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of ammonia and then bromine water, should it acquire a blue colour (absence of phenol). When added to an equal volume of alcohol it should form a clear solution (absence of copaiva and oil of turpentine).

Therapeutics.—Aromatic and carminative.

Official Preparations.—Infusium Aurantii Co.; Infusum Caryophylli; Mistura Ferri Aromatica; Oleum Caryophylli; Vinum Opii.

No. 86. Pimenta. Pimento.

Synonym:—*Allspice, Jamaica Pepper.*

The dried, unripe, full-grown fruit of *Pimenta officinalis* (*Eugenia Pimenta*).

Habitat.—The tree is indigenous to the West Indies and Central America; but the island of Jamaica supplies the bulk of that which is imported.

Collection.—The Allspice trees are usually planted in rows, called Pimento Walks, and require very little attention. The flowers are rapidly succeeded by the berries, and these, after attaining their full size, but still unripe, are removed, and spread out, and dried by exposure to the sun and air. They are frequently assorted according to size by shaking them through sieves of different degrees of fineness.

Characters.—Pimento consists of the nearly globular fruit, about $\frac{1}{5}$ of an inch in diameter, and crowned at the apex with the remains of the calyx in the form of a scar-like ring. Pericarp rough from the presence of oil glands, brittle, and of a reddish-brown colour, internally lighter, woody, two-celled, each containing a brown, roundish, reniform seed. Odour and taste warm, aromatic, resembling that of cloves.

Composition.—Pimento contains a volatile oil, an alkaloid, tannic acid, resin, and starch. The Volatile Oil, which is obtained by bruising the fruit and distilling with steam, separates as a pale yellow oil, becoming brown on keeping;

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it sinks in water. Specific gravity, 1.037. It consists of two oils, a light and a heavy oil, which are separated in the same way as oil of cloves. Oil of Pimento closely resembles oil of cloves, and yields about 60 per cent. of Eugenol, $C_{10}H_{12}O_2$, but it does not contain salicylic acid. The pericarp yields 10 per cent. of volatile oil, and the seeds 5 per cent. Pimento yields from 3 to $4\frac{1}{2}$ per cent. of volatile oil. (Bonastre.)

Therapeutics.—Stimulant and carminative.

Official Preparations.—Aqua Pimentæ, Oleum Pimentæ.

No. 87. Oleum Cajuputi. Oil of Cajuput.

The oil distilled from the leaves of *Melaleuca minor* (*Melaleuca Cajuputi*).

Habitat.—Indigenous in the East Indian Islands; but the oil is mainly obtained from the islands of Celebes and Bouro.

Preparation.—The leaves are collected and chopped up, then allowed to undergo fermentation, after which the oil is obtained by distillation. By allowing the leaves to undergo fermentation a greater yield of oil is obtained.

Characters.—Oil of cajuput is a transparent, limpid, volatile, pale bluish-green liquid, with a powerful, agreeable, camphoraceous odour, and a warm, bitterish, camphoraceous, afterwards cooling taste. Specific gravity from .914 to .930. Readily soluble in alcohol, fixed oils, and ether. On redistilling the oil it becomes colourless.

Composition.—The oil consists principally of cajuputene hydrate, or cajuputol, $C_{10}H_{16}H_2O$, and when fractionated the bulk distils over between 175° and 178° C. Pure cajuputene is readily obtained by distilling this fraction with phosphoric anhydride or zincic chloride. It possesses a faint odour of hyacinths, and is only sparingly soluble in alcohol. Two other isomeric modifications, namely, isocajuputene and paracajuputene, distil over after cajuputene has been separated.

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The peculiar bluish-green colour of the oil is mainly due to minute traces of copper ; but there are certain oils derived from *Metrosideros floribunda*, *Melaleuca*, and *Eucalyptus* species, which have a natural green hue, which becomes fainter on keeping, but on addition of strips of copper, and allowing to stand for some time, the colour becomes permanent. The presence of copper in any such oil is best detected by shaking with dilute hydrochloric acid, using equal volumes, decanting the watery layer, and either adding a few drops of ferrocyanide of potassium, when a brownish-red precipitate is formed, or pouring the solution into a platinum basin, and adding a few strips of zinc, when electrolytic action takes place, and the copper is deposited as a fine film on the platinum.

Adulteration.—Turpentine oil is sometimes met with in samples of this oil. The presence of this adulterant renders the oil much less soluble in alcohol, and when treated with iodine violent action takes place, whereas cajuput oil has only a faint action with iodine.

Therapeutics.—Stimulant and antispasmodic.

Official Preparations.—Linimentum Crotonis, Spiritus Cajuputi.

No. 88. Eucalyptus. *Eucalyptus* Leaves.

The leaves of *Eucalyptus globulus*.

Habitat.—This important genus is found throughout Australia and Tasmania. Several members have been introduced to the South of Europe, where they grow to large size.

Characters.—There are two varieties of leaves. Those obtained from the young plant are short, opposite, oval, or oblong, and of a pale bluish-green colour, covered with a whitish waxy bloom. The other variety is obtained from older plants. They are lanceolate, oblique at the base, and tapering to a fine point at the apex ; texture coriaceous ; colour greyish-green ; midrib prominent, from the base of

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which, running towards the apex, are seen two well-developed lateral veins. Throughout the mass of the leaf there are numerous pellucid oil ducts. Odour camphoraceous, taste warm, aromatic, and slightly bitter, followed by a sensation of coldness.

The flowers, which are frequently met with amongst the leaves, are liable at first to be mistaken for fruits. The calyx is united and woody, top-shaped, rough and warty, and covered with a peculiar whitish bloom. The upper portion is firmly connected with the corolla, forming the so-called operculum, which is in the form of a cone, and easily removed. Situated in a disc on the calyx are numerous yellow stamens. The ovary is firmly united to the calyx tube, and is five-celled.

Composition.—The leaves yield variable quantities of a volatile oil; they also contain tannin, a crystalline fatty acid, and resin.

Oleum Eucalypti, *Eucalyptus Oil.*—The oil distilled from the fresh leaves of *Eucalyptus globulus*, *Eucalyptus amygdalina*, and other species of *Eucalyptus*.

Preparation.—The leaves, and frequently the young twigs, are collected, and then submitted to distillation with water, and the light oil which separates from the aqueous distillate syphoned off. It is then allowed to stand in contact with calcium chloride to remove the last traces of water. As various species of *Eucalyptus* are utilised in preparing the oils, there necessarily exists considerable difference in their colour, odour, and specific gravity.

Characters.—The volatile oils are of a pale yellow or dark yellow colour, and sometimes colourless; these mobile fluids becoming darker in colour and thicker by age. Taste aromatic, pungent, and camphoraceous in the case of *E. globulus*, slightly resembling peppermint in that of *E. amygdalina*; whilst that yielded by the other species is more or less terebinthinate. An oil of a specific gravity above .880 should be soluble in its own weight of rectified spirit, and should dissolve not less than one-tenth of its weight of salicylic acid. That of a specific gravity below

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·880 should not require more than six volumes of rectified spirit for complete solution, and should dissolve one-sixteenth of its weight of salicylic acid (Mac Ewan). Generally the darker oils are the best.

Composition.—Oil of Eucalyptus varies in its composition, according to the source from which it is obtained. The oil of *E. globulus* contains about 60 per cent. of a terpene, eucalyptene, $C_{10}H_{16}$, and about 30 per cent. of cymene, $C_{10}H_{14}$, and an oxygenated hydrocarbon, $C_{10}H_{18}O$, called eucalyptol. Commercial eucalyptol is obtained by rectifying the oil over caustic potash until the product has a boiling point of $176^{\circ}C.$ or $177^{\circ}C.$ Pure eucalyptol may be obtained by distilling the oil and collecting the fraction coming over between 170° and $175^{\circ}C.$ then placing it in a freezing mixture, when the eucalyptol crystallises out. The crystals are purified by repeated recrystallisation.

Adulteration.—Turpentine oil, if present in eucalyptus oil, will diminish its solubility in alcohol, but commercial eucalyptus oil is now mainly obtained from *E. amygdalina*, or from several species included under the name of *E. dumosa*, and the difference observable in samples is principally due to the presence of varying amounts of these eucalyptus oils.

Species of Eucalyptus yielding Oils.

- E. viminalis.* Oil yellow green, odour disagreeable. Boils at 160° to $182^{\circ}C.$
E. obliqua. Oil reddish yellow, odour mild. Boils at 171° to $195^{\circ}C.$
E. odorata. Oil pale yellow, odour aromatic. Boils at 157° to $199^{\circ}C.$
E. longifolia. Odour camphoraceous, strong. Boils at 194° to $215^{\circ}C.$
E. rostrata. Oil pale yellow, odour aromatic. Boils at 131° to $181^{\circ}C.$
E. oleosa. Oil pale yellow, thin, odour mint-like. Boils at 161° to $177^{\circ}C.$

*Myrtaceæ.***No. 89. Granati Radicis Cortex. Pomegranate Root Bark.**

The dried bark of the root of *Punica Granatum*.

Habitat.—Indigenous to Palestine and Asia Minor; cultivated to a considerable extent in the South of Europe.

Characters.—The bark occurs in quills from 3 to 6 inches in length, or in fragments, externally of a brownish-grey colour, marked with corky ridges or warts, or cracked, with faint longitudinal striæ and depressions, internally of a reddish-yellow colour, smooth, having a short fracture and a greenish-yellow colour; no odour, but a bitter and astringent taste.

An infusion gives a black colour on the addition of ferric chloride.

Composition.—Pomegranate Root Bark contains tannic acid, mannitol, and an alkaloid named Pelletierine. Punico-tannic acid, $C_{20}H_{16}O_{13}$, is a peculiar tannin, insoluble in ether or alcohol; on hydrolysis it yields ellagic acid, $C_{14}H_{18}O_9$.

Mannitol is identical with that obtained from manna; several names were applied to it before its true nature was discovered.

Pelletierine or Punicine, $C_8H_{15}NO$, is a volatile alkaloid isolated by Tanret, and is obtained by mixing the powdered bark with milk of lime, percolating with water, and then exhausting the percolate by agitation with chloroform. It is an oily liquid, colourless, and readily soluble in water. Pelletierine was found associated in the bark with three other alkaloids, viz., isopelletierine, methylpelletierine, and pseudopelletierine. The root bark yields 1·24 per cent. of alkaloids, and the stem and branch bark ·35 to ·61 per cent.

Adulterations.—Box and Barberry barks are used sometimes to adulterate it; they are distinguished by having a bitter taste, and are destitute of astringency.

The rind of the fruit is frequently substituted for it; it occurs in flattish pieces, of a reddish-brown colour externally, and internally of a lighter colour, marked with numerous

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depressions caused by the seeds, some of the pieces having a portion of the toothed calyx adherent.

Therapeutics.—Vermifuge.

Official Preparation.—Decoctum Granati Radicis.

No. 90. Myrti Fructus. *Myrtle Berries.*

(*Not official.*)

The dried ripe berries of *Myrtus communis*.

Habitat.—A native of Western Asia, the myrtle has now become naturalised to Southern Europe.

Characters.—The fruit is a sub-globular, fleshy, purple black berry about the size of a pea, two-celled, each cell containing four small seeds reniform in shape; odour agreeable, taste sweetish and subacid.

Composition.—The fruit contains citric and malic acids, sugar, tannin, and a little resin and volatile oil.

The flowers and leaves distilled with water yield the fragrant *Eau d'ange*.

Therapeutics.—Aromatic and astringent.

CUCURBITACEÆ.**No. 91. Colocynthis Pulpa. *Colocynth Pulp.***

The dried peeled fruit, freed from seeds, of *Citrullus Colocynthis*. There are three commercial varieties, viz., Turkish, Spanish, Mogador, the last unpeeled. The Turkish variety affords more pulp in proportion to the seed.

Habitat.—The colocynth plant is met with in several countries in Asia, including India, Japan, Persia, and Asia Minor, and abundantly in the South of Europe and Northern Africa.

Characters.—The fruit, which is a pepo, is about the size and form of a large orange, covered with a thin parchment-like rind of a light brown colour, which is removed by

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slicing or scraping. As imported it is in roundish balls, more or less broken, colour white, very light, spongy, tough, and consisting of the pulp in which the seeds are imbedded. The pulp when freed from the seeds is without odour, but possesses an intensely bitter taste.

The fruit consists of about 25 per cent. of pulp and 75 per cent. of seeds, which contain 17 per cent. of fixed oil.

Composition.—Colocynth contains a glucoside, colocynthin, to the extent of ·25 per cent. only, and pectin, mucilaginous and gummy matter.

Colocynthin, $C_{56}H_{84}O_{23}$, can be prepared by exhausting the colocynth with water, concentrating the solution and agitating with amylic alcohol, which readily removes the colocynthin, the alcohol being recovered and the amorphous yellow mass purified by redissolving in water, precipitating with tannin and decomposing the salt with oxide of lead, then dissolving out with warm benzine and carefully evaporating. On hydrolysis with dilute sulphuric acid, it yields glucose and a resinous body, colocynthein. It gives a blood red colour with sulpho-molybdic acid.

Adulteration.—Frequently the seeds are powdered and mixed with the pulp; such an addition is best detected by percolating the pulp with benzine and allowing the percolate to evaporate, when an oily residue will be left if the seeds were present, also by the amount of ash, the pulp affording 11 per cent., and the seeds only 2·7 per cent.

Therapeutics.—A drastic purgative.

Official Preparations.—Extractum Colocynthidis Compositum; Pilula Colocynthidis Composita; Pilula Colocynthidis et Hyoscyami.

No. 92. Elaterium. *Elaterium.*

Synonym:—*Extractum Elaterii.*

A sediment from the juice of the squirting cucumber, Ecballium Elaterium (Ecballium officinarum.)

Cucurbitaceæ.

Habitat.—Indigenous to Southern Europe and Asia Minor. Cultivated in England at Hitchin and Mitcham, also in France.

Description.—The Squirting Cucumber is a coarse, hispid plant, decumbent in its habit, throwing up a thickened succulent stem to a height of about 2 feet, bearing coarse triangular leaves and unisexual flowers. The fruit is an ovoid pepo, about two inches in length, studded with a number of short prickles, and hangs from a recurved stalk; it is of a pale green colour, three-celled, and contains numerous seeds immersed in a thin mucilaginous juice having a bitter taste. When the fruit ripens, which is generally about September, it separates suddenly from the stalk, discharging at the same time the numerous light brown seeds and the watery juice surrounding them.

Preparation of Elaterium.—The nearly ripe fruits are carefully collected and then cut lengthwise, and the juice obtained by gently pressing the portions. Sometimes the contents are gouged out with the thumb, and the whole thrown on a hair-sieve and washed with a little water. The muddy liquid is set aside for some time, and then the clear supernatant liquid decanted; the sediment is then poured on a linen cloth and allowed to drain, then dried on porous tiles exposed to the sun's heat or in a drying closet. This process is the one recommended by Dr. Clutterbuck in 1820. The fruits afford about 0·123 per cent. of elaterium.

Characters.—Elaterium occurs in light friable flat or slightly curved opaque cakes, about one-tenth of an inch thick; pale green, greyish-green, or yellowish-green, according to age; fracture finely granular; odour faint, tea-like; taste bitter and acrid. It does not effervesce when treated with mineral acids; boiled with water and the decoction cooled, the addition of iodine affords little or no blue colour; when treated with rectified spirit it should give up about one-half its weight. Maltese Elaterium occurs in pieces nearly twice as thick as the English kind, and is less active.

Composition.—Elaterium contains a characteristic principle Elaterin, pectin, and gummy substances. According

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to Walz it also contains hydro-elaterin, an amorphous substance, soluble in alcohol and water but not glucosidal in its character; elateric acid or ecballin, an acrid resinous body, soluble in alcohol and alkalies; elateride, an intensely bitter substance, soluble in alcohol, insoluble in water; and prophetin, a glucoside, which is readily soluble in ether: the four substances amounting to nearly 9 per cent. It also contains a considerable quantity of chlorophyllous matter.

Determination of Elaterin.—Finely powder a weighed quantity of Elaterium, and intimately mix it with twice its weight of finely powdered pumice or washed sand, then pack in a small percolator and pass chloroform through the mixture until a drop evaporated on a watch-glass leaves no appreciable residue; recover the chloroform from the dark-green percolate by distillation, then wash the residue with anhydrous ether until the washings are free from colour, and carefully dry it on a water-bath and weigh. The process recommended by the Pharmacopœia of adding ether to the chloroformic solution does not completely precipitate the Elaterin. A sample of Maltese Elaterium gave by the above process 23 per cent. of Elaterin; good English Elaterium should yield about 30 per cent.

Elaterin, $C_{20}H_{28}O_5$, is a neutral principle, and occurs in small colourless hexagonal crystals, insoluble in water and petroleum ether, sparingly in cold alcohol, readily in boiling alcohol, chloroform, and amylic alcohol. It should leave no residue on incineration.

Colour Reactions of Elaterin.

On addition of Phenol and then strong Sulphuric Acid; bright crimson, changing to orange.

Nitric Acid and then warmed; red coloration.

Dissolved in strong Sulphuric Acid and then a fragment of Potassium Bichromate added; dark brown, on standing changing to light green.

Vanadic and Sulphuric Acids; fine blue, ultimately green.

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Therapeutics.—A powerful hydragogue cathartic.

Dose.— $\frac{1}{16}$ to $\frac{1}{2}$ grain.

Official Preparation.—Pulvis Elaterini Co.

UMBELLIFERÆ.**No. 93. Conii Folia. Hemlock Leaves.**

The fresh leaves and young branches of *Conium Maculatum*.

Habitat.—Indigenous throughout Europe and Northern Africa, naturalised in certain districts in America.

Characters.—Spotted Hemlock is a biennial plant, and during the first year produces only a small tuft of leaves; during the second year the stem increases in size, ultimately reaching a height of 5 or 6 ft. The lower leaves found on this stem are the largest, having a sheathing petiole which is more or less hollow. They are much divided, broadly ovate in outline and pinnately decomposed; the pinnæ being oblong-lanceolate, the upper ones toothed, and each lobe terminating in a white point, the entire leaf varying from 1 to 2 ft. in length. The upper leaves are much smaller and less decomposed, the petioles being almost absent. When fresh the leaves are of a dark green colour, lighter beneath, and on drying change to a greyish-green colour. Odour strong and disagreeable, resembling the urine of mice, increased on addition of solution of caustic potash. The lower portion of the stem is marked with numerous purplish spots, and at the base of the petioles there is a long reddish line.

Composition.—Hemlock Leaves lose on drying about 80 per cent. by weight. They contain a minute quantity of conine, which is combined with malic acid; it is contained in the juice obtained by expressing the leaves. The leaves on incineration leave about 12 or 13 per cent. of ash.

When conium leaves are chopped and moistened and kept at a temperature of 80° F. they undergo fermentation, and

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on submitting this product to distillation an essential oil distils over, which has a powerfully disagreeable odour and sharp burning taste.

Plants allied to Hemlock.—Amongst the plants sometimes mistaken for Hemlock are *Æthusa Cynapium*, species of *Chærophylum*, and *Anthriscus sylvestris*.

Æthusa Cynapium, Fool's Parsley, is a common weed, which may be distinguished by the absence of the general involucre and the long pendent involucre of three bracts on each partial umbel. The leaves resemble those of Hemlock in outline and subdivision, but when bruised emit a disagreeable fœtid alliaceous odour, and the ridges on the fruit are devoid of the wavy outline characteristic of Hemlock fruits.

Anthriscus sylvestris and *Chærophylum* species. The leaves of these plants do not possess the odour of conium, and their fruits are much more elongated, being linear-oblong.

Therapeutics.—Sedative and resolvent.

Official Preparations.—*Extractum Conii*; *Succus Conii*.

No. 94. Conii Fructus. Hemlock Fruit.

The fruit of *Conium maculatum*, gathered when fully developed, but while still green, and carefully dried.

Conium fruits, as met with, have generally become separated into their component mericarps. Each mericarp is about $\frac{1}{8}$ of an inch long, slightly compressed laterally, having a convex outer surface, marked with five crenate or wavy ridges, the intervening furrows being devoid of vittæ. Colour, grey-green or greyish. The fruits are almost inodorous until they are bruised, when they evolve the disagreeable odour of the leaves, particularly when moistened with a solution of potash. When a section is examined under the microscope, numerous cells of the endocarp are found filled with conine and oil.

Composition.—Hemlock fruits contain conine and its derivatives, methylconine and conhydrine, with small

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quantities of fatty and volatile oils, the latter closely resembling that of cumin; and malic and acetic acids.

Preparation of Conine.—Various processes are employed for the isolation of liquid volatile alkaloids, and the following method, devised by Loesch, gives satisfactory results:—

The drug is finely comminuted and then exhausted by percolation with 90 per cent. alcohol containing 10 per cent. of tartaric acid; from the percolate the bulk of the alcohol is recovered by distillation, and the residue carefully evaporated in a water bath; this extract is now mixed with one half its weight of milk of lime, and then submitted to distillation, the distillate being collected into 10 per cent. sulphuric acid and this solution evaporated, the residual sulphates of conine and ammonium are now macerated in strong alcohol, which removes conine sulphate; the alcohol is recovered, and the conine sulphate distilled from caustic potash, and purified by redistillation in a current of carbon dioxide.

Conine, $C_8H_{17}N$, is freed from conhydrine by careful redistillation, when the conhydrine is left in crystalline laminæ. Conine, when recently prepared, is a colourless, oily liquid, inflammable, sp. gr. .846, soluble in cold water, chloroform, alcohol, and ether. On oxidation it yields normal butyric acid; distilled with zinc dust, the hydrochlorate yields Conyryne, $C_8H_{11}N$, a pyridine base. Conine seems to be identical with α -isopropylpyridine (Ladenburg), differing from it only in the melting-point of the hydrochlorate and hydrobromate, and in being optically inactive. It forms crystalline salts with acids, which are soluble in alcohol and water.

Synthesis of Conine. This alkaloid is also prepared artificially by Ladenburg's process, who has also proved its identity with the natural alkaloid. By the action of metal sodium in an alcoholic solution of α -allylpyridine heated to the boiling point, α -allylpyridine becomes reduced to α -isopropylpyridine, which distils over. Conine prepared by this process is thus identical with α -isopropylpyridine.

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Methyl-Conine, $C_8H_{17}N, CH_3$, is reconverted into conine by treatment with hydriodic acid gas.

Therapeutics.—Sedative.

Official Preparation.—Tinctura Conii.

No. 95. Ajowan Fructus. *Ajowan, True Bishop's Weed.*

The dried ripe fruits of *Carum Ajowan* (*Ptychotis Ajowan, Ammi Copticum*).

Habitat.—India, cultivated in Persia and Egypt.

Characters.—Ajowan Fruits are very small, greyish-brown in colour, rough on the external surface, the taste is spicy and aromatic; when bruised, they exhale the odour of thyme. Each mericarp has five ridges, with a corresponding number of vittæ.

Composition.—When distilled, the fruits yield about 6 per cent. of a volatile oil to which they owe their marked aromatic taste.

The Volatile Oil is composed of two oils, a neutral liquid hydrocarbon left after extraction of the oxygenated oil by freezing, or by caustic soda. This liquid oil has been proved to be identical with cymene, $C_{10}H_{14}$; the oxygenated oil was found on examination to be thymol, $C_{10}H_{14}O$; the oil yields, on being submitted to cold, nearly 40 per cent. of thymol, which may be purified by redistilling from calcium chloride. It occurs in large tabular crystals, having the odour of thyme. They sink in cold water, but when melted, float on the surface. Sp. gr. 1.026. When heated the crystals volatilize entirely, melting between 110° F. and 123° F. Thymol forms with caustic soda a crystallisable and soluble compound.

Reactions of Thymol.—When dissolved in four parts of sulphuric acid and warmed, it forms a rose-red solution. This, when poured into ten volumes of water, lead carbonate being added in excess and the liquid allowed to stand, the clear solution decanted, and ferric chloride

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added to it, gives a violet-blue colour, due to sulphothymolic acid (Lallemand). When thymol is agitated with water, and the solution mixed with half its volume of glacial acetic acid and then an equal volume of sulphuric acid, it forms a reddish-violet solution (Hammarsten). When dissolved in chloroform or alcohol, and then potassium hydrate solution added, the solution assumes a red colour (Bembeck).

No. 96. Anethi Fructus. Dill Fruit.

The dried fruit of *Peucedanum graveolens* (*Anethum graveolens*).

Habitat.—Found wild throughout Southern Europe, Asia Minor, and the Caucasus; cultivated in India.

Characters.—The cremocarp is broadly oval, surrounded by a membranous wing of a paler colour. When fully ripe it separates into two mericarps, which are flat upon their face and somewhat convex at the back; three of the ridges are sharply keeled, the other two extend into the flattened margin. The odour is agreeable and aromatic; the taste sweetish and aromatic. Indian Dill fruits are more elongated and narrower, of a lighter colour, and more convex at the back. They are produced by *Anethum Sowa*, which is considered by some botanists to be identical with *A. graveolens*.

Composition.—Dill fruits yield, on distillation with water, about 4 per cent. of an essential oil; no further examination of the fruit has been carried out.

The Essential Oil is of a pale yellow colour, becoming darker on keeping; it possesses the agreeable aromatic odour of the fruit; when sulphuric acid is added to it a red colour is produced. It contains a neutral hydrocarbon anethene, $C_{10}H_{16}$, and an oxygenated portion identical with carvacrol, $C_{10}H_{14}O$, which constitutes nearly 30 per cent. of the oil (Nietzki). It is generally separated by agitating its alcoholic solution with ammonium sulphhydrate, when it separates as a crystalline compound, which is afterwards decomposed by an alkali.

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Therapeutics.—Carminative.

Official Preparations.—Aqua Anethi; Oleum Anethi.

No. 97. Anisi Fructus. *Anise Fruit.*

The dried fruit of *Pimpinella Anisum*.

Habitat.—Indigenous to Asia Minor, Egypt, and Greece; cultivated in Southern and Central Europe, America, and India.

Characters.—The fruits are about $\frac{1}{5}$ of an inch in length, the Russian variety being shorter. They are ovoid-oblong in form, of a grey-brown colour, and their entire surface is covered with short hairs. The two mericarps are always firmly united to the carpophore; each has five ridges, and on examining its transverse section fifteen vittæ are noticeable. The fruit has an agreeable aromatic odour, and sweet spicy taste.

Alicante Anise is the best, then the German.

Composition.—The fruits yield about 2 per cent. of volatile oil; they also contain gum, sugar, and fixed oil. The volatile oil is obtained by distilling the fruits with water; on cooling the oil separates from the aqueous distillate, and is easily removed. The Sp. gr. is from 0.977 to 0.983. It congeals between 50° and 60° F., and has an aromatic sweet taste; the oil consists of a neutral hydrocarbon, $C_{10}H_{16}$, in small quantities, but the principal constituent is anethol, $C_{10}H_{12}O$, which has two isomeric modifications. On oxidation with nitric or chromic acid it yields anisic acid, $C_8H_8O_3$; it dissolves in strong sulphuric acid with a red colour, and when diluted with water anison separates. The Russian oil contains a greater proportion of anisic aldehyd.

Adulterations.—The Fruit. Occasionally conium fruits have been found, having become admixed by accident; they are readily distinguished by the mericarps being separate, and by their smooth surface. Frequently earthy matter is added to the fruits: this is best detected by placing the fruit in water for a short time, when the heavy earth falls to the bottom of the vessel.

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The Volatile Oil. The principle adulterants are wax, camphor, and alcohol; the two former raise the congealing point of the oil, and the first is insoluble in alcohol; if camphor were present it would dissolve with the oil, but on pouring the solution into warm water the camphor will separate in flocculi. Alcohol is best detected by treatment with fuchsine, which, if present, will colour the oil.

Therapeutics.—Carminative.

Official Preparations.—Aqua Anisi; Oleum Anisi.

No. 98. Carui Fructus. *Caraway Fruit.*

The dried fruits of *Carum Carui* (*Carum Carvi*).

Habitat.—Indigenous to Europe and Asia. It is largely cultivated in Holland, Russia, Germany, England, United States, and Morocco.

Characters.—The fruits are generally separated into thin mericarps, which are from one-fourth to one-sixth of an inch long, somewhat curved, and tapering at the ends. Colour, brown; the surface is smooth, and the vittæ are conspicuous. Odour aromatic and agreeable; taste sweet, pleasant, and spicy.

In commerce the English caraways are considered the best, and command the highest price. They are shorter and more plump, and of a paler brown colour than the Dutch sort.

Composition.—The fruits contain a volatile oil, and a green fatty oil, besides sugar, tannin, and gum. The volatile oil is generally prepared by passing a current of superheated steam through the crushed fruits, which, by this process, have yielded as much as 8 per cent.; the first portion contains principally carvene, $C_{15}H_{24}O$, the latter portion containing chiefly carvol, $C_{10}H_{16}$. The oil is nearly colourless, or a pale yellow, becoming darker on keeping. Sp. gr. .90 to .97; when dissolved in alcohol, and then treated with ammonium sulphhydrate, it forms a white crystalline mass. When fractionated the carvene distils over first, the carvol boiling at a much higher temperature, viz., $445^{\circ} F$.

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The unripe fruits contain a notable quantity of tannic acid.

Therapeutics.—Carminative.

Official Preparations.—Aqua Carui; Confectio Opii; Confectio Piperis; Oleum Carui; Pulvis Opii Co.; Tinctura Cardamomi Co.; Tinctura Sennæ.

No. 99. Coriandri Fructus. Coriander Fruit.

The dried ripe fruit of *Coriandrum sativum*.

Habitat.—The Mediterranean region, naturalised in many European countries; cultivated on a small scale in England.

Characters.—Coriander fruits are nearly globular, the mericarps being closely united, about one-fifth of an inch in diameter. Colour brownish-yellow; hard, faintly ribbed with primary and secondary ridges; two vittæ are found on the commissural surface. Taste agreeable, mild, and aromatic; when bruised the fruits exhale a pleasant odour. When unripe, they, like the fresh plant, have a strong disagreeable odour.

Composition.—The fruits yield about 1 per cent. of volatile oil, but they also contain 14 per cent. of fatty oil, and a little tannin.

The volatile oil contains an oxygenated hydrocarbon isomeric with borneol, $C_{10}H_{18}O$, and also a neutral offensive smelling body, $C_{10}H_{16}$. The volatile oil is readily decomposed with strong nitric acid, forming a green coloured resinous substance.

Adulteration.—This oil is sometimes adulterated with essential oil of orange, which may be detected by heating a sample, or by the specific gravity, oil of coriander varying between the limit .860 to .877.

Therapeutics.—Carminative.

Official Preparations.—Confectio Sennæ; Oleum Coriandri; Syrupus Rhei; Tinctura Rhei; Tinctura Sennæ.

*Umbelliferae.***No. 100. Fœniculi Fructus.** *Fennel Fruit.*

The dried fruits of cultivated plants of *Fœniculum capillaceum* (*Fœniculum vulgare*.)

Habitat.—Indigenous to Southern Europe.

Characters.—From one-fifth to two-fifths of an inch in length, ovoid or oblong, slightly curved, surmounted by a prominent stylopodium, colour brown or greenish-brown. Smooth, with five prominent ridges on each mericarp, between the furrows are five vittæ, two occurring on the commissural surface. Odour aromatic, taste sweet, pleasant, and spicy. The fruits of the wild fennel are smaller and broader, darker in colour, and have a decided bitter taste.

Composition.—German and Roman Fennel yield on distillation about 4 per cent. of essential oil, besides which they contain 13 per cent. of fixed oil, and some sugar. The volatile oil is closely related to the oil of anise, consisting principally of anethol or anise camphor, $C_{10}H_{12}O$, and a hydrocarbon isomeric with terpene.

Test.—The oil after solution in alcohol should not give a dark colour on addition of ferric chloride (absence of phenol).

The oil is principally produced in France and Germany.

Therapeutics.—Carminative.

Official Preparations.—Aqua Fœniculi; Pulvis Glycyrrhizæ Co.

No. 101. Asafœtida. *Asafœtida.*

A gum-resin obtained by incision from the living root of *Ferula Narthex* (*Narthex Asafœtida*), and of *Ferula Scorodosma*, and probably other species.

Habitat.—The *Narthex* is found in Cashmir and Thibet, and the *Scorodosma* is found in Turkestan and Afghanistan, where it is largely cultivated.

Collection.—The natives first remove the soil from the roots during April, the leaves are then cut off and the

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upper portion of the bared root is protected against the sun's heat by a layer of leaves and earth, and in this condition it is allowed to remain a little over a month, at the end of which time the covering is removed and a slice taken off the root and the exuded juice removed, a day or two afterwards another slice is removed and time allowed for the juice to exude, the operation is repeated from time to time until the root is exhausted.

Towards the end of the cutting the best quality of Asafoetida is obtained.

Characters.—Asafoetida rarely occurs in tears, generally in irregular masses, varying in consistency and size, made up of a number of agglutinated tears. When broken or cut it presents an amygdaloid appearance; the fractured tears are opaque and milk-white, rapidly changing on exposure to the air to a purplish-pink or reddish-pink and finally to a yellowish-brown colour. Taste bitter, acrid, and alliaceous; odour strong, alliaceous, and persistent. When triturated with water it forms a white emulsion; the surface of a freshly fractured tear, when moistened with nitric acid, assumes in a short time a fine green colour. When rubbed with strong sulphuric acid, then diluted with water and neutralised with an alkali, the solution presents a bluish fluorescence. When treated with alcohol it should give up between 50 and 60 per cent. of its weight, and on incineration should not leave more than 10 per cent. of ash.

Commercially asafoetida is met with in two distinct qualities. The inferior, or second kind, which is largely admixed with earthly matter and stones, is called Hingra in Bombay.

Composition.—Asafoetida contains an essential oil, a resin, and gum.

The Essential Oil, which amounts to from 5 to 9 per cent. by weight of the drug, consists of a mixture of several sulphides of ferulyl or laseryl, C_6H_{11} (Flückiger). It has a strong persistent disagreeable odour, and when recently distilled is of a pale yellow colour, becoming darker on

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keeping. When dissolved in alcohol, and a drop of bromine added, it develops a violet-red colour.

The Resin varies from 45 to 65 per cent., and contains ferulaic acid, $C_{10}H_{10}O_4$, soluble in water, from which it crystallises in needles. Fused with caustic potash, this acid yields protocatechuic, oxalic, and carbonic acids. It can also be obtained from Vanillin or Eugenol, to which it is closely related. The brown amorphous resin, on fusion with potash, yields resorcin $C_6H_4(OH)_2$, and when submitted to dry distillation affords umbelliferone, $C_9H_6O_3$.

The Gum, which amounts to about 30 per cent., is closely related to gum acacia.

Adulteration.—The principal impurity consists of earthy matter, which sometimes amounts to 40 and even 50 per cent.; it is best detected by incinerating a sample.

Therapeutics.—A powerful antispasmodic.

Official Preparations.—Enema Asafœtidæ; Pilula Asafœtidæ Composita; Pilula Aloes et Asafœtidæ; Spiritus Ammoniae Fœtidus; Tinctura Asafœtidæ.

No. 102. Galbanum. *Galbanum.*

A gum-resin obtained from *Ferula galbaniflua*, *Ferula rubricaulis*, and probably other species.

Habitat.—The former is found mostly in Northern Persia and the latter in Southern Persia; other members of the genus are found in the Kirghiz Steppes.

Characters.—The finest quality of galbanum is found in tears varying considerably in size, or in masses of agglutinated tears; sometimes soft and semi-fluid. The tears are roundish or irregular in form, and vary in size from that of a lentil to a hazel nut, generally being about the size of a pea; in colour they are of various shades, orange-brown, greenish-yellow, or light brown, slightly translucent, usually rough or dirty on the surface, and when kept in the cold they become quite brittle and easily powdered, when held in the hand they become plastic and sticky. The lump galbanum consists of masses of different

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degrees of softness, and on examination numerous impurities are found, such as thin slices of the stem or root, small stones and pieces of clay, &c. In colour it is generally of a dark brown. Both qualities possess a strong, disagreeable, slightly balsamic odour. The taste is bitter, alliaceous, and unpleasant. When moistened with alcohol, and then with nitric acid, a purple colour is produced, and when a small portion is macerated in weak ammonia water a fine blue fluorescence is produced, due to umbelliferone.

Composition.—Galbanum contains an essential oil, resin, and gum. Crude samples usually contain about 16 per cent. of impurities.

The Essential Oil is best obtained by distilling the galbanum with water and separating the oil from the distillate, and allowing it to stand in contact with fused calcium chloride for a short time, the yield being 8 per cent. It is colourless when first prepared, of sp. gr. .901, but becomes dark yellow and viscid on keeping. It consists partly of several hydrocarbons of the type $C_{10}H_{16}$ and is dextrogyrate.

The Resin. This constitutes from 50 to 60 per cent. of the drug, and after separation of the essential oil, it can be extracted by treating the residue with ether, in which it dissolves quite readily.

It is a brownish-yellow substance, soluble in solution of potash, alcohol, and only partially so in carbon bisulphide. It yields on dry distillation two peculiar volatile oils, which when first prepared are of a beautiful dark-blue colour; these, on fractionation yield a colourless oil, $C_{10}H_{16}$ (the higher fraction has an intense blue colour, and has a formula of $C_{30}H_{48}O_3$), which when examined by Kachler appeared to be identical with the oil of *Matricaria Chamomilla*. When the resin is digested with four times its weight of hydrochloric acid at a temperature of 200° F. for some time, and the solution agitated with chloroform, on evaporation of the chloroform small needle-shaped colourless crystals of umbelliferone are left. Umbelliferone $C_6H_3(OH)C_2H_2CO_2$, is the product of the dry distillation of many resins, and is closely related to daphnetin. It

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dissolves in solution of the alkalies, forming fine blue fluorescent solutions; boiled with caustic soda it yields resorcin, $C_6H_4(OH)_2$, formic, carbonic, and acetic acids. The resin when fused with caustic potash yields nearly 6 per cent. of resorcin, the solution of which reduces silver salts and gives a purple colour with ferric chloride. The resin when warmed with nitric acid yields trinitroresorcin or styphnic acid $C_6H(NO_2)_3(OH)_2$ and camphretic acid (Gmelin).

The Gum. This body is apparently a modification of arabinose, with which it closely agrees in its reactions. It constitutes about 20 per cent. of the galbanum.

Chemical Reaction to distinguish between Galbanum, Asafœtida, and Ammoniacum.

Take a portion of the isolated resin or the crude gum-resin and warm it with pure strong hydrochloric acid for about five minutes, then slowly drop into the solution some alcohol, when the following colours will be produced.

Galbanum—first red, then bluish-violet.

Asafœtida—murky green.

Ammoniacum—unaffected.

Therapeutics.—Antispasmodic and expectorant.

Official Preparations.—Emplastrum Galbani; Pilula Asafœtidæ Co.

No. 103. Ammoniacum. *Ammoniacum.*

A gum-resinous exudation from the stem (after being punctured by beetles) of *Dorema Ammoniacum* and probably of *Dorema Aucheri*.

Habitat.—Found principally in the barren districts of Persia and the Steppes of Tartary.

Collection.—The plant is infested to a remarkable extent by a peculiar beetle which punctures the stem, and in this way the milky juice exudes and rapidly dries into tears, which generally remain attached to the branches or stem, and are usually gathered during the months of June and July.

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Characters.—Ammoniacum of best quality is always in tears, varying between $\frac{1}{16}$ and $\frac{1}{2}$ an inch in diameter. They are of an irregular rounded or sub-globular form, and externally of a pale cinnamon-brown colour, or white if recent, but internally milk-white; when broken the fracture presents a waxy appearance; the tears become quite brittle when kept in the cold for some time, and are easily reduced to powder. The odour is faint, increased on heating; the taste bitter, acrid and nauseous. When triturated with water it forms a milky-white emulsion.

Lump Ammoniacum is often of inferior quality, consisting of densely agglutinated tears. It is usually prepared by making a transverse section of the crown of the root; and it contains a number of impurities, amongst which a large number of the ovoid fruits are easily recognised. When Ammoniacum is moistened with chlorinated lime or soda it acquires a bright orange colour.

Composition.—Ammoniacum consists of a mixture of resin, volatile oil, gum, and about 6 per cent. of moisture.

The Resin. This body constitutes about 66 to 72 per cent. of the drug, and is composed of two resins, one being acid and the other neutral; they can be separated by ether, in which only one is soluble. When fused with caustic potash it yields a little resorcin, oxalic and acetic acids, but no umbelliferone.

The Volatile Oil. The amount varies considerably, but the mean of four analyses gave 2·8 per cent. Its alcoholic solution treated with neutral ferric chloride assumes a reddish-brown colour. When kept in contact with silver foil it does not affect it, thus confirming Moss's statement that the oil does not contain sulphur.

The Gum. Usually amounts to about 24 per cent., and consists of 18 to 20 per cent. of arabin and about 4 per cent. of bassorin.

Allied Drugs.—African Ammoniacum obtained from *Ferula Tingitana*, found growing principally in Morocco. It is rarely met with in English commerce, and can be readily distinguished by its more aromatic odour and the absence of a bitter taste. It contains about 70 per cent. of

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resin, 2 per cent. volatile oil, 10 per cent. gum, the residue being chiefly insoluble matter. It also yields umbelliferone on distillation (Hirschsohn).

Opopanax is a gum-resin said to be derived from *Opopanax Chironium* (*Pastinaca Opopanax*), a plant indigenous to Southern Europe. It occurs in small tears of a reddish-brown colour and waxy fracture: odour strong and disagreeable; taste bitter, balsamic, slightly acrid. It contains a resin, volatile oil, and gum.

Sagapenum is a gum-resin derived from a species of *Ferula* growing in Persia. It has an alliaceous taste and odour.

Therapeutics.—Expectorant and local irritant.

Official Preparations.—Emplastrum Ammoniaci cum Hydrargyro; Mistura Ammoniaci; Pilula Scillæ Co.; Pilula Ipecacuanhæ cum Scillâ.

No. 104. Sumbul Radix. Sumbul Root.

The dried transverse sections of the root of *Ferula Sumbul* (*Euryangium Sumbul*).

Habitat.—Found growing in Bokhara, Turkestan, and Central Asia.

Characters.—The entire root is about 12 to 16 inches in length, and spindle-shaped; but the transverse slices vary considerably in size, being usually 1 to 3 inches in diameter and about 1 to 2 inches long. The sections are of a light spongy texture, and the dusky brown papery cortex is annulated, frequently having small fibrous rootlets; internally the structure is marked with numerous resin ducts, and is farinaceous and fibrous; taste bitter and aromatic; odour strong and musk-like.

Composition.—Sumbul Root contains about 9 per cent. of resin, which is soluble in strong sulphuric acid, forming a crimson coloured solution, and also soluble in ether. When treated with caustic potash, it yields sumbulamic and sumbulic acid (angelic acid) as potassium salts, those

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of the latter being the more soluble. The resin when destructively distilled yields umbelliferone. The root also contains a small quantity of volatile oil and a doubtful alkaloid sumbuline (Murawjeff).

Adulteration.—The so-called Indian Sumbul is not the root of a species of Sumbul, but has been proved by Dymock to be derived from *Dorema Ammoniacum*, which is devoid of the musklike odour. It is much harder, firmer, and denser.

Therapeutics.—Stimulant.

Official Preparation.—Tinctura Sumbul.

ARALIACEÆ.**No. 105. *Panax Radix.* Ginseng Root.**

(*Not official.*)

The washed and dried root of *Panax quinquefolium* (*Aralia quinquefolium*), and of *Panax Schinseng*.

Habitat.—The former is found indigenous throughout North America, and the latter collected in Japan, Corea, and China.

Characters.—The American Ginseng Root is in fusiform pieces about 3 inches in length, marked by a number of transverse ridges, so as to appear closely annulated. It divides towards the point into two or three branches. Externally the root is of a light cinnamon-brown colour; internally white, fracture short and mealy; taste aromatic and sweet; odour agreeable. The Chinese Ginseng Root is of somewhat darker colour and of a horny appearance, due to a partial baking to which the roots are submitted.

Composition.—Ginseng contains a resin, gum, starch, and a sweet principle, panaquilon, $C_{12}H_{25}O_9$, which is precipitated from its solution by sodium sulphate. It is soluble in alcohol, from which it is precipitated by tannin; strong sulphuric acid dissolves it, forming at the same time a red solution, decomposing it into panacon, $C_{11}H_{19}O_4$. (Garriques).

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Therapeutics.—The Chinese esteem ginseng root as a powerful aphrodisiac ; but from trials of the same root in this country it has entirely failed to establish its reputation.

COROLLIFLORÆ.

CAPRIFOLIACEÆ.

No. 106. Sambuci Flores. Elder Flowers.

The fresh flowers of *Sambucus nigra*. From indigenous plants.

Habitat.—Indigenous throughout Europe.

Characters.—The elder produces large corymbose cymes, about 5 inches in diameter ; they are five-branched below and subdivided above. Flowers small, marginal ones radiate ; calyx superior, minutely five-toothed, rotate in form, and pale yellow in colour ; corolla flat, rotate, tube short, with five spreading lobes, whitish, having five stamens inserted in the tube. Odour, when fresh, disagreeable ; on drying they acquire a sweet, pleasant smell. Taste bitter and mucilaginous. When elder flowers are well dried they are of a dull yellow colour.

Composition.—Elder flowers yield on distillation nearly .5 per cent. of a yellowish, limpid volatile oil, possessing in a marked degree the odour of the drug.

Official Preparation.—Aqua Sambuci.

RUBIACEÆ.

Sub-order Cinchoneæ.

No. 107. Cinchonæ Cortex. Cinchona Bark.

The dried bark of any species of *Cinchona* from which the peculiar alkaloids of the bark may be extracted.

Habitat.—The genus *Cinchona*, of which there are between thirty and forty species, are indigenous to South

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America, and are found principally on the western side of that continent. All the plants are found growing on the higher elevations of the Andes and Córdilleras, the average altitude being from 5,000 to 8,000 ft.; the extreme limit given by Karsten being a little over 10,000 ft. None of the species are found growing on the low alluvial plains; they grow in the primeval forests; usually a few species are found congregated together, or they are found singly. The area in which the best varieties are found includes the countries of Bolivia, Venezuela, Peru, Ecuador, and New Granada.

The climate of the cinchoniferous region is one of extreme variability, heavy rains falling during the night time; the rainy season continuing for a period of nine months. The rain is succeeded by bright sunshine, alternating with thick mist or fog, the temperature generally ranging 75° F., and during the night falling below freezing point.

Habitats of Cultivated Cinchonas.—During the last twenty years many species of cinchona have been cultivated in other countries, particularly on the Neilgherry Mountains, near Ootacamund, and on the Sikhim Himalayan range in India; in the mountainous regions of Ceylon, Java, and Jamaica, and more recently the cultivation has been attempted in Africa and Cape de Verde Islands. The cause of the enormous impetus given to the cultivation of cinchonas first originated from the destructive method of collection carried on in South America, and the continuous demand for large quantities of the bark.

Collection.—In South America, the cascarilleros, or bark collectors, having found a tree, first remove the under-shrub, and thus make a clearing; then they remove the bark from the trunk and larger roots, which is first loosened by beating with a stick; the object being to remove the thick suberous layer; but on some varieties this layer naturally exfoliates. The removed bark is then spread out and piled up in layers, crossing one another at right angles; finally some heavy weight is placed on the top; this prevents the pieces from becoming quilled. After complete drying, the bark is examined, and all the bad pieces

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removed. The remainder is then packed in boxes or bales; sometimes it is enclosed in hides, constituting what is called a seron. After removal of the trunk bark, the tree is felled, and the bark removed from the branches; this is then spread out in sheds and dried, forming the quilled barks of commerce.

In India, Ceylon, and Java, and other places where the cinchonas are cultivated, several methods of collection are resorted to, the principal being coppicing, shaving, and mossing.

Coppicing consists in cutting the main axis at the root, and removing the bark. From the crown of the root spring numerous secondary axes, and these in a few years have their bark removed.

Shaving.—This process, which was first used by Moens in Java, consists in removing the outer layers of the bark by a spoke-shave, or other instrument suitable for the purpose. Great care is taken to leave sufficient covering to protect the cambium layer underneath, so as to preserve the vitality of the tree. After a lapse of three or four years the process can be repeated; only limited portions of the bark are treated at one time.

Mossing.—This process was first suggested by Karsten, and finally carried out by McIvor and others. Long strips of the bark are removed, and the surface afterwards wrapped over with a covering of moss to protect the cambium layer. This method has been almost superseded by shaving. Barks obtained by this method are much richer in alkaloidal contents.

Uprooting.—When the plants are almost exhausted, they are pulled up, and the bark removed from the root. This bark is also rich in alkaloids.

Barks prepared by the process of mossing and shaving are in commerce known as renewed barks, and constitute about 95 per cent. of the present import of true *Cinchona* bark.

Commerce.—In South America the barks are principally exported from the ports of Guayaquill, in Ecuador (red); Payta and Callao, in Peru (pale). Arica and Islay export



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N^o 108.

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the bark of Bolivia (yellow); Savanilla (Columbian or Carthagena). East Indian bark is exported from Colombo, Madras, Bombay, and Batavia. West Indian Bark comes from Jamaica.

No. 108. Cinchonæ Rubræ Cortex. *Red Cinchona Bark.*

The dried bark of the stem and branches of *Cinchona succirubra*.

The S. American bark is met with in flat pieces or quills, and the Indian renewed bark in quills, chips or shavings.

Characters.—Flat pieces; the bark of the trunk or old wood is generally in incurved pieces, varying from $\frac{1}{2}$ to 2 inches in thickness, and 4 to 12 inches in length; it is coated with a suberous layer, which is very rough and marked with numerous warts or ridges, and occasionally with longitudinal fissures, and is sometimes of a soft and spongy texture; its inner surface is closely striate, fibrous, and of a dull red colour; fracture short and fibrous; the pieces are usually dense and heavy; taste astringent and bitter; no marked odour.

Quills.—This form of bark is generally about $\frac{1}{4}$ of an inch to an inch in width, and from 6 in. to 2 or 3 ft. in length, and is either single or compound. The young form of this bark is covered externally by a thin silvery layer, which is marked by a netted arrangement of cork cells; in the older forms there are numerous warts of a paler hue, and it is rough from longitudinal ridges caused by the confluence of the corky warts. The suberous layer is of different shades of colour, from greyish-brown to rust-brown; older barks being of a reddish-brown colour; it is marked with occasional transverse cracks or annular fissures. The inner surface is of a cinnamon brown colour in young quills; and in the thicker or older quills, of a brick red or reddish-brown colour; it is also irregularly and coarsely striated; fracture finely fibrous; powder brown or brownish-red; taste astringent and bitter.

Renewed Chips or Shavings.—This, which has lately become the most common form of red bark, occurs in

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small, occasionally in larger channelled pieces; externally it is marked with numerous small light coloured warts, which in older pieces have become united to form a number of ridges; internally it is generally of a brownish-red colour; it varies considerably in its characters, depending on the length of time it has been allowed to grow; in thickness it rarely exceeds $\frac{1}{8}$ of an inch, but more frequently it is of a papery texture. It is a valuable form of red bark.

Structurally, red bark is characterised by an abundance of laticiferous ducts, mostly of considerable diameter, and by narrow medullary rays in the inner bast layer, also by radially arranged bast fibres occurring in interspersed lines, and by the liber fibres being smaller and more scattered than in *Calisaya* bark.

Red Bark is the one now official for the preparations of the Pharmacopœia. The bulk of red bark is imported from the East Indies.

Composition.—It should yield between 5 and 6 per cent. of total alkaloids, of which half should consist of Quinine and Cinchonidine.

Official Preparations.—Decoctum Cinchonæ; Extractum Cinchonæ Liquidum; Infusum Cinchonæ Acidum; Mistura Ferri Aromatica; Tinctura Cinchonæ; Tinctura Cinchonæ Composita.

No. 109. Cinchonæ Flavæ Cortex. *Yellow Cinchona Bark.*

The dried bark of the stem and branches of *Cinchona Calisaya*.

This bark occurs in commerce in coated quills, but very rarely in flat pieces; it was at one time considered the most valuable kind of *Cinchona* bark.

Flat Calisaya.—This form of the bark is met with in irregular pieces from 12 to 18 inches in length, and 3 to 5 inches in breadth, and about a $\frac{1}{4}$ to $\frac{1}{3}$ of an inch in thickness. The suberous layer is rarely present, being removed before the bark is dried; sometimes pieces of the bark are marked with isolated patches of a dark brown colour, which are due



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to remains of the suberous layer; but it usually consists solely of the liber bark. Its colour is of a reddish orange-brown; it is irregular, presenting a grooved appearance (the so-called digital furrows); the inner surface is smooth and marked with very fine undulating or wavy striæ; texture uniform and fibrous; fracture finely fibrous, and the fibres of the fractured end are very short and easily removed.

Quill Calisaya is found in single or double quills, varying in size and length; the older quills are about 1 inch in diameter, covered with a greyish corky layer, which is fissured by deep transverse cracks, the edges of which are slightly elevated; the corky layer is in some cases thick and rugged, and can be easily removed with the finger nail; the exposed surface is of a light cinnamon-brown colour, and the inner surface of a dark brown colour, and finely fibrous with minute wavy striæ. The transverse fracture is short and fibrous, and the powder of a light cinnamon-brown colour. *Quill Calisaya* is generally in much thicker quills than either red or pale bark.

Structurally, the characteristics of *Calisaya* bark consist in the liber fibres being almost isolated by parenchymatous cells. In *C. scrobiculata*, which bears a strong external resemblance to *Calisaya*, these fibres form radial rows. The bark also is thinner than that of *Calisaya*.

The Flat *Calisaya* at present occurring in commerce is not the true bark, but is derived from *C. Peruviana*, *C. ovata*, and other species. It is prepared in the same way, and bears some resemblance to the true *Calisaya*, but the bark is rougher on the inner surface, and does not present a wavy grain. This bark constitutes the bulk of the South American Flat Yellow of commerce, and contains little or no quinine.

When *Calisaya* occurs in small quills it is best distinguished from the quills of *Cinchona officinalis* by the greater number of longitudinal furrows.

The finest kind of yellow bark is obtained from *Cinchona Calisaya*, *var. Ledgeriana*, which yields the *rojo* bark rich in alkaloids; it is cultivated to a considerable extent in Java. It is thicker than ordinary *Calisaya* bark.

No. 110. Cinchonæ Pallidæ Cortex. *Pale Cinchona Bark.*

The dried bark of *Cinchona officinalis*, *var. Condaminea*, *Bonplandiana* and *crispa*, and occasionally of *Cinchona micrantha*.

This bark is known as Loxa, Crown, Huanuco, Lima or Grey Bark. It is now largely cultivated in India and the East Indies, and occurs in two forms, quills and chips. Indian Pale Bark is much richer in quinine than that from South America, which is often of a very mixed character.

Quilled Pale Bark. The quills are from $\frac{1}{8}$ to $\frac{3}{4}$ of an inch in diameter, and vary much in size and appearance; the larger quills are sometimes double, and have a blackish-brown to greyish colour on the outer surface, which is also marked with numerous small transverse cracks, forming an irregular network, and is usually spotted with silver-grey lichens, which are sometimes very large and may be closely attached to the quill, or hang from it as a mass of fibrous material. The inner surface is finely striate, and is of a light yellowish or cinnamon-brown colour; fracture fibrous, the fractured end showing fine short fibres on the inner surface, and somewhat long ones on the outer surface; taste astringent and bitter, with a characteristic odour.

Renewed Chips. This form of bark, which is principally imported from Ceylon and India, always occurs in small shavings, and may usually be distinguished from the shavings of red bark by their paler appearance on the outer surface; but it must of a necessity follow that barks which are submitted to this treatment should bear a close resemblance to one another, and this makes it a point of extreme difficulty to recognise them.

Pale Bark, obtained from *Cinchona micrantha*, is generally of a lighter grey colour, softer and more corky externally, and the transverse fissures not so well marked, and the bast fibres of the inner surface are nearly always in scattered groups, and there is a total absence of laticiferous ducts, so characteristic of young quills of *C. officinalis*.

*Rubiaceæ.***No. 111. Cinchonæ Carthagenæ Cortex.** *Carthagena Bark.*

The dried bark, with the suberous layer more or less removed, of *Cinchona cordifolia*, *Cinchona lancifolia*, *C. scrobiculata*, and other species.

This bark is almost entirely shipped from South America, and is known in commerce as Columbian, Coqueta, New Granada, or Carthagena Bark, and it is further distinguished as hard or soft Columbian Bark.

No. 112. Cinchonæ Cordifoliæ Cortex. *Hard Columbian Bark.*

This bark is generally in incurved pieces, from $\frac{1}{8}$ to a $\frac{1}{4}$ of an inch thick, 1 or 2 inches broad, and about 6 inches in length; externally it is somewhat rough, and marked with glossy patches of the mesophlœum; the inner surface is striate, but rarely presents a wavy outline; the colour is brownish-yellow; it is hard, and breaks internally with a long, and externally with a short fracture; the broken ends being marked with long fibres which are easily removed.

No. 113. Cinchonæ Lancifoliæ Cortex. *Soft Columbian Bark.*

The barks are either in flat pieces or thick quills. From the natural tendency of these and other species of *Cinchona* to exfoliate the outer suberous layer, they present a smooth appearance externally, which is marked sometimes all over with the shining, white, thin layer of the mesophlœum. The inner surface is finely striate, and of a brownish-yellow or orange-brown colour; fracture long and fibrous; taste bitter and astringent. These barks are sometimes called fibrous Calisaya bark, and are principally used for the preparation of the alkaloids.

Numerous other varieties of *Cinchona* are cultivated for their bark, and hybridisation is now resorted to for the purpose of selecting only those species, and the hybrids obtained

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from them, which are rich in alkaloidal contents. There are also a few other plants which are not Cinchonas, the barks of which yield the alkaloids characteristic of the Cinchonas, remarkable amongst these being two varieties of *Remijia*.

The following table will show the principal varieties of Cinchonas which yield barks found in commerce.

Cinchona Barks of Commerce.

Cinchona	Calisaya				
„	„	Var. Ledgeriana			} Yellow Bark.
„	„	„ Boliviana			
Cinchona	succirubra	(two forms)			} Red Bark.
„	coccinea	... ..		
„	conglomerata	... ..		
„	erythrantha	... ..		
Cinchona	officinalis				
„	„	Var. crispa			} Pale Bark.
„	„	„ Bonplandiana			
„	„	„ Condaminea			
Cinchona	lancifolia	... ..			} Columbian Bark.
„	scorbiculata	... ..		
„	cordifolia	... ..		
Cinchona	nitida	... ..			} Grey Bark.
„	Peruviana	... ..		
„	micrantha	... ..		
Cinchona	Pitayensis	... ..			Pitayo Bark.
Cinchona	pubescens.				
„	robusta.				

Grahe's Test for Cinchona Barks.

The principle of this test is based on the fact that all Cinchona barks, or nearly all, contain variable proportions of alkaloids and astringent matter ; and that these alkaloids, when heated, undergo decomposition and yield a reddish oily distillate ; therefore Grahe introduces some of the finely powdered bark in a test tube, and places the test tube in a Bunsen flame ; in a short time a dark red oily liquid condenses on the upper and colder portion of the tube. The reliability of this test is further increased by previously moistening the bark with an alcoholic extract of a portion

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of the bark; or by adding a small quantity of any volatile acid; this reaction indicates the presence of alkaloid in the bark. Cinchona bark from which the alkaloid has been removed by prolonged percolation with dilute hydrochloric acid, does not give this reaction. The presence of the characteristic bast fibres taken in connection with this reaction is considered a test of the genuineness of Cinchona.

Composition of Cinchona Barks.

Cinchona barks contain, as their most important constituents, several alkaloids, the chief of which are quinine, quinidine, cinchonine, cinchonidine, and quinamine, and a number of minor importance, which differ principally in their physical appearance and chemical reactions. Together with the alkaloids there occur cinchotannic, kinic, and quinovic acids, quinovin and cinchona-red. The alkaloids principally occur as cinchotannates and kinates. When Cinchona barks are exhausted and the total alkaloids precipitated such a mixture of alkaloids is known under the name of quinetum, and, according to Oudemans, principally consists of cinchonine, cinchonidine, quinine, quinamine, and amorphous alkaloid.

Quinine, $C_{20}H_{24}N_2O_2 \cdot 3H_2O$. This, the most important alkaloid in cinchona bark, forms colourless needle-shaped crystals, but is generally met with as a crystalline powder, fusing at $57^\circ C.$; it is inodorous, and possesses a marked persistent bitter taste, and when kept over strong sulphuric acid, becomes anhydrous. It is a strong base, neutralising acids, and forming crystalline salts; it is soluble in two parts of absolute alcohol, but requires six parts of rectified spirit; it is also soluble in chloroform, readily in carbon disulphide, ether, and amylic alcohol; it is soluble in two thousand parts of cold water, but dissolves more freely in boiling water, or glycerine. Its solution in dilute sulphuric acid exhibits a blue fluorescence, which is destroyed when hydrochloric acid is added. When freshly precipitated it dissolves in a considerable excess of solution of ammonia. On the addition of chlorine water, or better, bromine water, and then solution of ammonia, to solutions

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containing quinine, a dark emerald green colour is produced, or in very strong solutions a green precipitate; this is due to the formation of thalleioquin or dalleiochine; if the quinine solution is added to chlorine or bromine water, then a few drops of potassium ferrocyanide or ferricyanide solution added, and finally the ammonia solution, a fine crimson-red colour is produced. Quinine dissolved in alcohol is lævorotatory; when quinine is treated with a boiling solution of potassium permanganate it yields ammonia, oxalic acid, and tricarbo-pyridenic acid $C_5H_2N(COOH)_3$; on warming a crystal of quinine or any of its salts with Fröhde's reagent it forms a green coloured solution.

Amongst the numerous salts of this alkaloid the following are of most frequent occurrence in commerce.

Quinine Disulphate $(C_{20}H_{24}N_2O_2)_2H_2SO_4 \cdot 7H_2O$.

Quinine Sulphate $C_{20}H_{24}N_2O_2 \cdot H_2SO_4 \cdot 7H_2O$.

Quinine Hydrochlorate $C_{20}H_{24}N_2O_2 \cdot HCl \cdot H_2O$.

Quinine Hydrobromate $C_{20}H_{24}N_2O_2 \cdot HBr \cdot 2H_2O$.

Quinine Valerianate $C_{20}H_{24}N_2O_2 \cdot C_5H_{10}O_2 \cdot 2H_2O$.

Quinine Salicylate $C_{20}H_{24}N_2O_2 \cdot C_7H_6O_3 \cdot 3H_2O$.

The most important is the disulphate, which is manufactured on a large scale. It crystallises in fine needles, and forms a rather bulky powder; it is soluble in 32 parts of boiling water; but the solution on cooling deposits most of the salt.

It is frequently adulterated by the addition of the sulphates of the other alkaloids of the bark, and particularly amorphous quinine. The following test by Hesse serves to indicate the presence of other sulphates: 1 gram of the salt is added to 7 c.c. of a mixture of 2 parts of chloroform and 1 part of absolute alcohol; on warming the mixture between 100° and 122° F. it should form a clear solution, which should remain so on cooling. Other tests are enumerated in the Pharmacopœia. Amorphous quinine is best detected by first dissolving in dilute acid, then precipitating with ammonia, removing the alkaloid with ether, decanting the ethereal layer and evaporating to dryness; then converting into neutral oxalate, drying on a water

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bath, dissolving in chloroform and adding a few drops of water and agitating, when amorphous alkaloid if present will impart a faint yellow colour to the water. Quinine when dissolved in proof spirit and a few drops of dilute sulphuric acid, and then a solution of iodine added, throws down a brown precipitate, which on dissolving in boiling alcohol crystallises on cooling, in shiny plates, known as herapathite. The crystals are well known on account of their peculiar optical properties. This salt contains 56.55 per cent. of alkaloid quinine, and is used as a method for determining the percentage of the quinine.

Commercial Manufacture of Quinine.—The following method is employed in India in manufacturing quinine on a large scale. The bark is reduced to an extremely fine powder (No. 120), and mixed in the proportion of 100 parts of bark to 500 parts of water containing 8 parts of caustic soda; and then are added 600 parts of a mixture containing amylic alcohol 1 part and kerosine oil 4 parts. The mixture is briskly agitated in large vessels for several hours and then allowed to rest, and the oily layer removed. The oily liquid is shaken for a short time with dilute sulphuric acid, which removes the alkaloids; after separating, the oil is removed and used again on the bark and the process repeated until all alkaloid is removed. The acid aqueous solution is now neutralised with soda or ammonia and set aside to crystallise, the crystals are drained on a cloth, redissolved in 50 times their weight of boiling water, filtered through charcoal and recrystallised. (Gammie.)

Quinidine, $C_{20}H_{24}N_2O_2 \cdot 2H_2O$. This alkaloid crystallises from alcohol in fine efflorescent prisms, melting at $168^\circ C$. It is found in larger quantity in Pitayo bark and *C. rosulenta* than in most other barks; although always occurring in smaller quantity than the other alkaloids. The alcoholic solution is dextrorotatory, and it requires a larger proportion of ether for solution than quinine. This alkaloid agrees with quinine in many respects, particularly as regards bitterness, fluorescence of its solution, and the formation of the thalleioquin, but it principally differs from quinine in the marked insolubility of its hydriodate, which requires nearly 1300 parts of water for solution. But

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quinidine sulphate is much more soluble in chloroform than quinine sulphate. Advantage is taken of the sparing solubility of the hydriodate of quinidine as a means of separating this alkaloid from quinine. When oxidised with chromic acid, this alkaloid, like quinine, yields carbonic anhydride and quininic acid, $C_{11} H_9 NO_3$, and with potassium permanganate it gives pyridene-tricarboxylic acid, $C_5H_2 N(COOH)_3$.

Several salts of quinidine are met with, the following being the more common ones :—

Quinidine Disulphate, $(C_{20} H_{24} N_2 O_2)_2 H_2 SO_4 \cdot 2 H_2 O$.

Quinidine Hydriodate, $C_{20} H_{24} N_2 O_2 HI \cdot 2 H_2 O$.

Quinidine Hydrochlorate, $C_{20} H_{24} N_2 O_2 HCl \cdot 3 H_2 O$.

When quinidine sulphate solution is dropped on to a glass slide, and then a drop of potassium thiocyanate added, it forms fine radiating feathery microscopic crystals.

Quinamine, $C_{19} H_{24} N_2 O_2$. This alkaloid is found more particularly with the amorphous alkaloid obtained from *C. succirubra*. It is usually separated from the amorphous alkaloid by dissolving in weak acetic acid, then adding a solution of potassium thiocyanate until it acquires a pale yellow colour. It is then allowed to stand until it clears, and the limpid portion withdrawn and rendered alkaline with ammonia solution, after which it is shaken with ether. On removing the ethereal layer and evaporating it on a water bath quinamine remains, which may be crystallised from boiling alcohol. It is isomeric with conquinamine, and its alcoholic solution is dextrorotatory. It crystallises from alcohol in fine needles, and its solution in dilute sulphuric acid is not fluorescent, nor does it give the thalleioquin reaction, and the solution of quinamine in hydrochloric acid gives a yellow precipitate with auric chloride, which on standing changes to purple. When quinamine sulphate is heated it is converted into protoquinamidine, but when boiled with dilute sulphuric acid it yields amorphous quinamidine. When heated in a sealed tube with hydrochloric acid it gives apoquinamine, $C_{19} H_{22} N_2 O$.

The more common salts of quinamine are the—

Quinamine Hydrochlorate, $C_{19} H_{24} N_2 O_2 HCl \cdot H_2 O$.

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Quinamine Hydrobromate, $C_{19} H_{24} N_2 O_2 HBr, H_2 O$.

Quinamine Disulphate, $(C_{19} H_{24} N_2 O_2)_2 H_2 SO_4 2H_2 O$.

Cinchonine, $C_{20} H_{24} N_2 O$. This alkaloid is generally obtained from the mother liquor by precipitation with caustic soda. It crystallises from alcohol in prisms which are anhydrous. Its solution is dextrorotatory. When dissolved in dilute acid it forms a non-fluorescent solution, and does not give the thalleioquin test. It is almost insoluble in water, moderately soluble in amylic alcohol. When mixed with caustic potash and distilled it yields chinoline or quinoline, $C_9 H_7 N$, with small quantities of lepidine, $C_{10} H_9 N$, and cryptidine, $C_{11} H_{11} N$. They are nitrile bases and their alkyl-iodo compounds form blues called cyanines. By oxidation with potassium permanganate it yields cinchonic (quinoline carbonic) acid, $C_9 H_6 NCOOH$. The principal salts of cinchonine are—

Cinchonine Disulphate, $(C_{20} H_{24} N_2 O)_2 H_2 SO_4, 2H_2 O$.

Cinchonine Hydrochlorate, $C_{20} H_{24} N_2 O HCl, 2H_2 O$.

The hydriodate of cinchonine is readily soluble in water.

Cinchonidine, $C_{19} H_{22} N_2 O$. This alkaloid ranks next to quinine in importance, and is found in considerable quantities in *C. succirubra*, *C. officinalis*, and *C. pubescens*. In its characters it agrees closely with cinchonine, but differs from it in the sparing solubility of its tartrate, and is precipitated along with quinine from a faintly acid solution of the alkaloids as a double tartrate. It is freed from quinine by a solution of the double tartrate in dilute sulphuric acid and precipitation of the former as the iodo-sulphate. Cinchonidine forms anhydrous crystals which are lævorotatory. It forms crystalline salts with acids, of which the sulphate is the more important salt. Cinchonidine disulphate, $(C_{19} H_{22} N_2 O)_2 H_2 SO_4, 6H_2 O$, crystallises in fine prisms. They are almost insoluble in ether, soluble in chloroform, and the solution is non-fluorescent, and does not give the thalleioquin reaction. The alkaloid is completely precipitated from its solutions by potassium thiocyanate. When submitted to treatment with potassium permanganate it yields cinchotenidine, $C_{18} H_{20} N_2 O_3$.

Amongst the less frequently occurring alkaloids there are aricine, cusconine, paytime, cinchonicine, hydroquinine,

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conquinine, hydrocinchonidine, javanine, and cusconidine. Many of these are isomeric modifications of the more well-known alkaloids.

Characters of the more important Alkaloids.—

	Quinine.	Cinchonidine.	Quinidine.	Cinchonine.
Solubility in ether ...	freely	sparingly	freely	almost insoluble
Solubility in alcohol ...	freely	soluble 1 in 20	soluble 1 in 30	sparingly
Solution in dilute sulphuric acid	fluorescent	non-fluorescent	fluorescent	non-fluorescent
Bromine water and ammonia	thalleioquin	white precipitate	thalleioquin	white precipitate
Bromine water, ferrocyanide and ammonia ...	fine red	colourless	fine red	colourless
Rotary power	lævogyrate	lævogyrate	dextrogyrate	dextrogyrate

Kinic or Quinic Acid, $C_7H_{12}O_6$. This acid is also found in coffee seeds, the bilberry, and in several plants of the Rubiaceæ. On precipitating the alkaloids from an acid extract of the bark with hydrate of calcium, it remains in solution as a calcium salt; and on evaporating the solution is obtained in rhombic crystals, having a formula of $(C_7H_{11}O_6)_2Ca, 10H_2O$. The pure acid can be obtained by treating the calcium salt with oxalic acid. It is freely soluble in water, and on oxidation with manganese dioxide and sulphuric acid it is converted into formic and carbonic acids and quinone, $C_6H_4O_2$. On dry distillation it yields pyrocatechin, hydroquinone, phenol, and benzoic acid. On fusion with caustic potash it yields protocatechuic acid.

Cinchotannic Acid is best prepared from a concentrated decoction, which has first been digested, in contact with magnesia (which removes the cinchona red) for two or three hours, then filtering, and adding a solution of plumbic acetate, collecting the precipitate and suspending it in water, and decomposing with sulphuretted hydrogen; the solution is then carefully evaporated under diminished pressure, when it is left as a pale yellow amorphous mass.

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It is readily soluble in water, and the solution strikes a green colour with ferric chloride; by boiling with dilute sulphuric acid it yields glucose and cinchona red.

Quinovic Acid, $C_{24}H_{38}O_4$. This acid principally results from the decomposition of quinovin. It is insoluble in chloroform and water, readily soluble in alkaline hydrates, and in solutions of their carbonates.

Quinovin or Chinovin, $C_{30}H_{46}O_8$, is an amorphous bitter principle, and is sometimes called quinova bitter. It is freely soluble in alcohol, and has a persistent disagreeable bitter taste; and on treatment with dilute sulphuric acid it is decomposed into kinovin, sugar, and quinovic acid.

Cinchona Red is an amorphous body, to which the red colour of cinchona barks is due. It exists to a large extent in the thick, flat, dark red pieces of *C. succirubra*. It is almost insoluble in water, but readily soluble in alkaline hydrates and alcohol. When fused with caustic potash it yields protocathechuic acid.

Assay of Cinchona Bark. A number of processes are employed for determining the alkaloidal contents of cinchona bark, the principal aim being to rapidly and completely exhaust the bark of its total alkaloids; the subsequent separation of the mixed alkaloids being unattended with difficulty.

British Pharmacopœia Method. This process is divided into two parts; first, estimation of quinine and cinchonidine, and, second, estimation of total alkaloids. Process: 200 grains of bark in No. 60 powder are mixed with 60 grains of slaked lime, and then moistened with half an ounce of water, and the mixture allowed to stand two hours. The moist powder is then transferred to a flask and boiled repeatedly with benzolated amylic alcohol, the liquid being drawn off after each boiling. The residue is then exhausted by percolation with the benzolated amylic alcohol. The united liquids are now placed in a stoppered separator, and to this is added 20 minims of diluted hydrochloric acid, previously mixed with 2 fluid drachms of water; shaken well and then allowed to separate, the acid liquid is drawn off, rendered exactly neutral with

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ammonia, and evaporated to 3 fluid drachms. Then about 15 grains of tartrated soda, dissolved in twice its weight of water, are added, and the mixture well stirred, set aside for one hour, and filtered, the filter is then washed (the washings being added to the filtrate), dried and weighed. The resulting insoluble tartrates of quinine and cinchonidine contain eight-tenths of their weight of the alkaloids, which, divided by two, will give the percentage. If now to the mother liquor, ammonia be added in excess, and the resulting precipitate collected, washed, dried and weighed, and this weight divided by two, the result added to the preceding weight will give the percentage of total alkaloids. This process is an unsatisfactory one, as the bulk of fluid required to exhaust 200 grains of bark is difficult to manipulate, and the time required to complete an assay is a little under 12 hours.

Reactions which take place during the estimation.

1. The lime is used to set free the alkaloids, by combining with the acids.
2. The benzolated amylic alcohol dissolves the alkaloids out and thus exhausts the bark.
3. The hydrochloric acid combines with the alkaloids to form hydrochlorates.
4. The solution of ammonia is added to neutralise the excess of acid.
5. The tartrated soda precipitates the quinine and cinchonidine as insoluble tartrates.
6. Excess of ammonia is added to precipitate the remaining alkaloids.

Amongst several methods, tried from time to time, the following has given fairly accurate results, and may be used for a direct estimation of total alkaloids, De Vrij's process being afterwards resorted to for determining the individual percentages; or the quinine and cinchonidine may be estimated after the method of the Pharmacopœia:— 10 grammes of cinchona in No. 80 powder are mixed with 3 grammes of hydrate of calcium and 2 cc. of water added, well mixed, and then dried on a water bath; the powder is then packed in a suitable percolator and exhausted with a

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mixture of 4 parts of chloroform and 1 part of amyllic alcohol, the percolation being best carried out in a continuous apparatus, 120 cc. are sufficient for exhaustion; the percolate is then agitated twice with 12 cc. of dilute hydrochloric acid, using 6 cc. at a time; the united acid solutions are rendered alkaline with caustic soda, and the precipitate is collected, washed, dried, and weighed; the result multiplied by 10 will give the percentage of total alkaloids.

Analysis of some samples of Cinchona bark. There is a considerable variation in the proportion of the alkaloids: the following analysis will give a fair representation of the percentage composition of some of the barks as now imported.

South American Barks.

	Quinine.	Quinidine.	Cinchonine.	Cinchonidine.	Total Alkaloids.
Red	1·86	0·12	0·71	2·42	5·11
Yellow	1·92	—	0·62	·81	3·35
Pale	·86	·31	1·06	·35	2·58

East Indian Barks.

	Quinine.	Quinidine.	Cinchonine.	Cinchonidine.	Total Alkaloids.
Red	4·2	trace	·8	2·4	7·4
Yellow (quill)	1·75	·24	·85	·73	3·57
Pale (shavings)	3·61	·52	1·16	2·15	7·44

Some East Indian barks have yielded as much as 8 per cent. of quinine, and they are to be preferred to the present South American imports.

No. 114. Cortex Remijiaë. *Cuprea Bark.*

The dried bark from the stem and branches of *Remijia pedunculata* and *Remijia Purdieana*.

Habitat.—The cuprea, or copper coloured bark, as found in commerce is obtained from two distinct districts, viz., Southern Bogota, near the Orinoko, and the lower part of the Magdalena river, in the mountainous ranges adjoining Bucaramanga, in Colombia.

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Peculiarities.—The genus *Remijia* is closely related to the genera *Cinchona* and *Cascarilla*. The average altitude at which the species grow is about 2700 feet. Bark imported from that elevation has been found to be the richest in alkaloids. When the powdered bark is submitted to Grahe's test, it does not yield the reddish distillate of a true *Cinchona* bark, but a brown tarry liquid possessing the same characteristic odour as that from *Cinchona* bark.

Characters.—*Cuprea* Bark usually occurs in quills or channelled pieces, or in fragments, varying considerably in length, diameter, and thickness. Externally they are sometimes covered with a brownish-grey suberous layer, which is marked with longitudinal ridges, presenting a netted appearance, or in older pieces this layer becomes slightly fissured transversely, and very rough or warty; internally it is of a copper-red colour, and marked with longitudinal striæ. It is very hard, heavy, and compact, fracture coarsely granular, taste bitter and astringent.

Composition.—Foremost amongst the alkaloids of the bark of *R. pedunculata* is a new alkaloid, discovered almost simultaneously by Dr. B. H. Paul and Mr. A. J. Cownley, Messrs. Howard and Hodgkin and Mr. Whiffin, called homoquinine. The bark of *R. Purdieana* has yielded to Hesse, cinchonine, cinchonamine, chairamine, conchairamine, chairamidine, conchairamidine, and concusconine.

Homoquinine, $C_{19}H_{22}N_2O_2$. (?) Hesse. Several methods have been employed for the extraction of the alkaloids, considerable difficulty being experienced in obtaining them free from colouring matter. Arnaud's method consists in exhausting the bark with dilute sulphuric acid, precipitating the alkaloids with milk of lime, collecting the precipitate, drying, and then exhausting this with ether, and agitating the ether with dilute hydrochloric acid. Homoquinine crystallises from the ether solution in flat prisms or laminæ. It is readily soluble in chloroform, alcohol, and in dilute sulphuric acid, forming a blue fluorescent solution which gives the thalleoquin reaction; it forms with acids a series of crystallisable salts. The exact composition of

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homoquinine was quite recently demonstrated by Paul and Cownley, who were the first to prove this body, to be a compound of quinine and a new base which they named cupreine, which possesses the peculiar character of forming a crystallisable compound with sodium hydrate. When homoquinine is treated with an excess of caustic soda and agitated with ether, and the ethereal layer allowed to evaporate, it deposits crystals of quinine, the alkaline solution containing the cupreine sodium compound; on neutralising this with dilute sulphuric acid, and then adding potassium iodide, the solution deposits sparingly soluble crystals of cupreine hydriodate. Messrs. Paul and Cownley have also synthesised homoquinine by agitating together the two bases with ether, when crystals of homoquinine separated. They ultimately proved the composition of homoquinine to be

Cupreine	60·92
Quinine	39·08
<hr/>	
	100·00

Cupreine. This base is sparingly soluble in strong alcohol, from which it crystallises in warty groups of small crystals. It is readily soluble in a solution of sodium hydrate, and in dilute acid, the solution in the latter being nonfluorescent. Cupreine is detected in commercial quinine salts by dissolving the salt in acidulated water, precipitating the quinine with sodium hydrate, filtering and carefully neutralising the filtrate with dilute sulphuric acid, then agitating with ether or collecting the precipitated cupreine on a filter paper. Most probably this base has a phenolic construction, which would partly account for its solubility in caustic alkalies.

The following alkaloids are found in the bark of *C. Purdieana*.

Cinchonamine, $C_{20}H_{26}N_2O$ (Hesse), is readily soluble in ether, chloroform, and hot alcohol; its chief characteristic consists in the remarkable insolubility of its nitrate in cold water containing nitric acid. It forms a series of crystalline salts with acids.

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Concusconine, $C_{23}H_{26}N_2O_4H_2O$, crystallises from alcohol in faintly yellow crystals, melting at $144^{\circ}C$. Its solution in acetic acid is coloured green by nitric acid, the sulphate is crystalline, but the remaining salts are nearly all gelatinous.

Chairamine, $C_{22}H_{26}N_2O_4H_2O$, forms a hydrochlorate which is insoluble in dilute hydrochloric acid.

Conchairamine, $C_{22}H_{26}N_2O_4$, Chairamidine, and Conchairamidine, $C_{22}H_{26}N_2O_4H_2O$, are closely related to Chairamine.

The bark of *C. pedunculata* is used as a source of quinine; it yields from $\frac{1}{2}$ to 3 per cent. of total alkaloid.

SUB-ORDER COFFEEÆ.**No. 115. *Ipecacuanha Radix*. *Ipecacuanha Root*.**

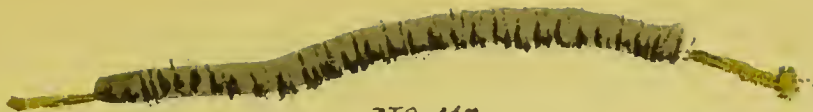
The dried root of *Cephaëlis Ipecacuanha*.

Habitat.—This plant, of which there are two varieties, one with an herbaceous and the other with a woody stem, is found growing in the damp forests of Brazil and New Granada. The cultivation has been attempted in the Sikkim Himalaya, in India, but with little success.

Characters.—*Ipecacuanha* root occurs in somewhat twisted or curved pieces, from 2 to 4 inches in length, and about $\frac{1}{6}$ of an inch in diameter; the very small and thin roots should be rejected. It is composed of two parts, namely:—a central inert whitish axis, which is tough and minutely porous, and a thick cortical or active portion, which is brittle, finely wrinkled, and closely annulated by projecting circles. It is brown, greyish-brown, or reddish-brown in colour, and has a resinous waxy fracture; taste, slightly acrid and bitter; odour, musty and nauseous. The bark amounts to about 80 per cent. by weight of the root.

Composition.—*Ipecacuanha* contains emetine, ipecacuanhic acid, erythrocephalein, a trace of volatile oil, sugar, gum, and pectin.

Emetine, $C_{20}H_{34}N_2O_5(?)$. This is the most important constituent of *ipecacuanha*; it exists to the extent of about



N^o 115.



N^o 117.



N^o 134.



N^o 135.



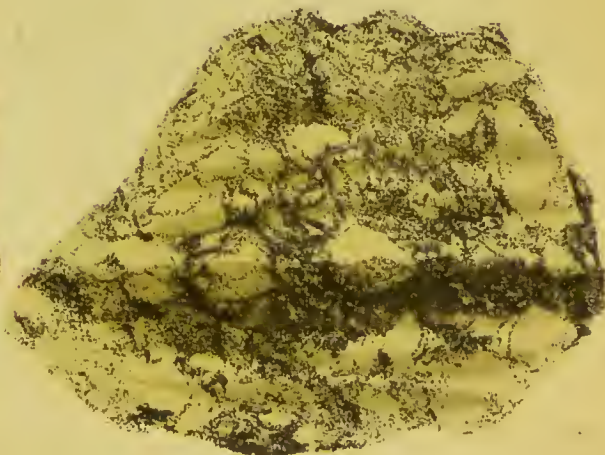
N^o 119.



N^o 122.



N^o 130.
(4)



N^o 130.
(1)

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1 per cent. ; the higher proportions that have been mentioned refer to impure alkaloid. It separates from hot petroleum ether on cooling, in white plates, but as usually met with it is a light greyish powder. It is readily soluble in ether, chloroform, amylic alcohol, and essential oils. It neutralises acids, forming amorphous salts which are readily soluble in water, from which it is precipitated on addition of potassium nitrate, tannin, or Mayer's solution.

Colour Reactions of Emetine.

Fröhde's reagent	...	...	Red, changing to green, which on addition of a drop of strong hydrochloric acid, turns to deep indigo blue.
Nitric Acid	...	...	Blood red.
Chlorinated Lime and Acetic Acid	...	...	Bright yellow to orange.
Sulphuric Acid	...	...	Brown and then green.

Ipecacuanhic or Ipecacuanha-tannic Acid, $C_{14}H_{18}O_7$, is found in considerable quantity in the root, and its alcoholic solution strikes a green colour with neutral ferric chloride. It is a brown amorphous powder ; hygroscopic, bitter, readily soluble in alcohol ; it is apparently a glucosidal tannin, and was at one time considered identical with gallic acid. Erythrocephalein is the colouring principle of the root, and is easily extracted by alcohol. The volatile oil when isolated has a fetid, nauseous odour.

Assay of Ipecacuanha. — Several methods have been employed in the assay of this drug, amongst them the volumetric method of Dragendorff, which consists in exhausting the drug with 90 per cent. alcohol, then evaporating, and treating the residue with water ; finally titrating the solution with Mayer's solution, 1 cc. of which equals .0189 gram emetine. The following process by Podwysotzki gives good results. First, percolate the ipecacuanha with ether, which removes wax and fat ; then warm the powder to expel the ether. Exhaust with 90 per cent. alcohol ; evaporate the tincture to the consistency of syrup ;

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add to this a solution of ferric chloride, and then sodium carbonate until an alkaline reaction is produced. Then treat the magma with hot petroleum ether, and decant the ethereal layer ; on cooling white flakes of emetine are deposited.

Tests.—Mix 1 gram of ipecacuanha with one-third its weight of slaked lime, and moisten the powder with a drop of water, and then dry, exhaust the dried mixture by percolation with 3 cc. of chloroform ; evaporate off the chloroform, and add to the residue a drop or two of a strong solution of potassium nitrate, when an amorphous precipitate of emetine nitrate is formed.

Adulterations.—Imported ipecacuanha is frequently mixed with the stem of the same plant, which is readily distinguished by the smooth surface and absence of rings, and well developed woody centre, which does not present the finely porous structure of that part of the root. As there are several emetic roots found in South America, the following may occasionally be met with in commerce.

1. Striated Ipecacuanha, the root of *Psychotria emetica*. The bark is of a deep brown colour, and marked by a few deep irregular transverse fissures, and numerous longitudinal striæ, and is nearly $\frac{1}{3}$ of an inch thick ; taste at first sweet, then bitter.

2. Undulated Ipecacuanha, the root of *Richardsonia scabra*. The bark contains a large quantity of starch, and is of a whitish appearance internally, brown externally ; fissured on alternate sides and irregularly undulate.

3. Rio Ipecacuanha, the root of *Ionidium Ipecacuanha*, *Violaceæ*. This twisted and tortuous root is about six inches in length ; of a yellow or light grey colour, and peculiar musty odour. It may readily be distinguished from true ipecacuanha by its larger size, more woody texture, and by being branched.

Goanese Ipecacuanha is derived from *Naregamia alata*, *Meliaceæ*. Its emetic properties are due to an alkaloid, nargamine, which is not identical with emetine. This drug is largely used by the Portuguese at Goa.

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Therapeutics.—Expectorant, diaphoretic, and emetic.

Official Preparations.—Pilula Conii; Pilula Ipecacuanhæ cum Scillâ; Pulvis Ipecacuanhæ Compositus; Trochisci Ipecacuanhæ; Trochisci Morphinæ et Ipecacuanhæ; Vinum Ipecacuanhæ.

No. 116. Coffea. Coffee.

The seeds of the fruit of *Coffea arabica*, *Coffea liberica*, and other species.

Habitat.—The coffee plant is indigenous to Central Africa and the Mozambique coast; and it has been introduced and cultivated to a large extent in Ceylon, Java, and other East Indian islands, South America, and the West Indies.

Characters.—The coffee plants sometimes reach a height of thirty feet, and bear numerous oval drupaceous fruits of a dark purple hue, bearing two plano-convex seeds, arranged with their flat sides towards one another. The fruit of *Coffea liberica* is nearly twice as large as that of *Coffea arabica*. The seeds are usually divested of their enclosing endocarp; the testa is finely wrinkled, and on the flat side there is a deep groove. The embryo is situated at one end on the convex side; in form the seeds are oval; they vary in the shade of colour, and possess a faint peculiar odour, and a slightly sweet astringent taste. On drying the seeds the flavour is considerably improved.

Preparation.—Coffee seeds, prior to use, are submitted to a process of roasting at a temperature of about 450° F. for some time, when they assume a dark reddish-brown colour, and become very brittle and easily reduced to powder, and at the same time they acquire a more agreeable taste, and yield a greater portion of soluble matter to water. During the roasting, certain changes of the constituents take place, more particularly of the tannin and fat, producing amongst other products a pyrogenated volatile oil, to which the characteristic aroma is due.

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Composition.—Coffee contains caffeine, caffeeo-tannic acid, coffee fat, and glucose.

Caffeine, $C_8H_{10}N_4O_2, H_2O$. This alkaloid, which exists in coffee partly in a combined form, as caffeeo-tannate (chlorogenate) and partly free, amounts to between 1 and 1.5 per cent. A variable amount is lost during roasting, as it sublimes in fine crystals at a temperature of $180^{\circ}F$. It forms numerous salts with acids, but on concentration dissociation takes place, forming a mere mixture; it is soluble in alcohol, water, and readily so in chloroform. It is just probable that this body may be prepared from Peruvian guano, which contains guanine, which is easily converted into xanthine, of which theobromine is the dimethyl derivative and caffeine the trimethyl derivative.

Caffeo-tannic acid, $C_{14}H_8O_7$, can be readily obtained from a decoction of coffee by precipitation with lead acetate, collecting the precipitated citrate and caffeeo-tannate of lead, washing with water, and finally decomposing with sulphuretted hydrogen. It is a yellow amorphous brittle mass, readily soluble in alcohol or water; its solutions give a green coloration with ferric chloride. When fused with solid caustic potash it yields protocatechuic acid, and on dry distillation yields pryocatechin. On boiling with dilute potash solution, and then neutralising with dilute sulphuric acid, crystals of Caffaic acid, $C_9H_8O_4$ separate, leaving glucose in solution; caffeeic acid yields the same decomposition products as caffeeo-tannic acid.

Coffee Fat. This body, which is found to the extent of 14 per cent., consists of the glycerides of palmitic and oleic acids, and of an acid of the formula $C_{12}H_{24}O_2$; it is easily extracted by alcohol, from which it separates on cooling to $0^{\circ}F$. as a crystalline mass.

Caffeol or Oil of Coffee. Caffeol is one of the products of the roasting of coffee, and according to Berheimer, has a formula of $C_8H_{10}O_2$, who regards it as the methyl-ether of Saligenin, since by oxidation it yields Salicylic acid.

Official Preparation.—Caffeina.

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SUB-ORDER NAUCLEÆ.

No. 117. Catechu. *Catechu*.

Synonyms:—*Gambier*, *Catechu Pallidum*.

An extract of the leaves and young shoots of *Uncaria Gambier*. It is also prepared from *Uncaria acida*.

Habitat.—It is a native of the countries bordering the Straits of Malacca, Ceylon, and Sumatra; and cultivated to a large extent near Singapore.

Preparation.—The leaves and young shoots are removed from the plant, placed in earthen vessels containing water, and boiled for some time, or until a strong decoction is made; this is then removed, and the residue expressed, generally with the hands. The decoction is evaporated to the consistency of a syrupy liquid, and then poured into buckets and stirred, when it gradually sets into a stiff mass, which is poured into shallow boxes, and allowed to stand until sufficiently firm, when it is cut into cubes, and finally dried in the shade.

Gambier is chiefly exported from Singapore.

Characters.—Gambier occurs in cubes or masses of variable size and form; sometimes in masses of agglutinated cubes. The cubes are about an inch square on each side, of a dark reddish-brown colour externally, light cinnamon brown or buff internally; they are dry, porous, friable, and break with a dull, earthy fracture. Taste astringent, and at first bitter, subsequently sweetish. When examined under the microscope, catechu is seen to consist principally of minute crystals. It is partially soluble in cold water, almost entirely in boiling water; but the solution on cooling deposits a precipitate. When treated with hot alcohol it yields a clear brown liquid, and the undissolved residue should not amount to more than 15 or 16 per cent. by weight.

Composition.—In composition gambier is similar to cutch; namely, catechu-tannic acid, catechin or catechuic acid, quercetin, and possibly quinovic acid.

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Catechu-tannic Acid ($C_{38}H_{34}O_{15}$) is most probably formed from catechin by the abstraction of the elements of water (Etti). Various methods have been employed in estimating tannins (see Tannins), but most of them are unsatisfactory. Lehman found from 25 to 38 per cent. of tannin in gambier when examined by his method, no other constituent being precipitated.

Catechin or Catechuic Acid ($C_{19}H_{18}O_8$) is most readily extracted by agitating the powdered drug with acetic ether or ether, and carefully evaporating off the solvent; and for estimation the residue may be weighed or titrated with a decinormal solution of permanganate of potassium. Catechin, when warmed with strong sulphuric acid, gives a purple colour, changing to black. Its solution in ammonia acquires a variety of colours, from scarlet to black, this is caused by the gradual absorption of oxygen; and it gives with ferric chloride a green colour. It does not precipitate gelatine, but acts as a strong reducing agent, and yields pyrocatechin on distillation.

Quercetin ($C_{15}H_{12}O_7$) was detected by Hlasiwetz. It is only sparingly soluble in ether; readily soluble in alkaline hydrates and alcohol. It also dissolves in hot water, from which it can be removed by agitation with amylic alcohol.

Therapeutics.—Astringent.

Official Preparations.—Infusum Catechu; Pulvis Catechu Co.; Tinctura Catechu; and Trochisci Catechu.

VALERIANACEÆ.**No. 118. Valerianæ Rhizoma. *Valerian Rhizome.***

The dried rhizome and rootlets of *Valeriana officinalis*. Collected in autumn from plants growing wild or cultivated in Britain.

Habitat.—Indigenous to Europe, cultivated in Holland, and in this country, principally in Derbyshire. The wild plant presents a number of aberrant forms.

Characters.—Valerian rhizome is a short, upright rhizome with a truncate end, entire or sliced, dark yellowish-brown

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externally, giving off numerous brittle, light greyish-brown shrivelled rootlets, 2 or 3 inches long. Internally the rhizome and rootlets present a white appearance. When fresh the rhizome is fleshy, with a very slight odour, which becomes strong and disagreeable on drying. . Taste camphoraceous, slightly bitter, and unpleasant.

Composition.—Valerian contains tannin, resin, sugar, and a volatile oil, which is its principal constituent.

The volatile oil is obtained by distilling the drug with water, the quantity obtained varies from .5 to 2 per cent. ; the largest percentage being obtained from valerian grown in dry places. When freshly prepared it is of a light greenish-yellow colour, and neutral to test paper; after a time it becomes darker in colour and acid in reaction. When dissolved in bisulphide of carbon and treated with nitric acid it becomes blue ; it dissolves in all proportions in alcohol. It consists of a hydrocarbon, valerene or borneene, and valerol, but Bruylants, who contests this, states that the oil contains the alcohol borneol and its valerianic ether ; and he further explains the formation of valerianic acid as due to the decomposition of that salt. The oil also contains formic and acetic acids, ethereal salts of borneol.

Adulterations.—Occasionally this drug has been sophisticated with mixtures of poisonous rhizomes, amongst which have been found the rhizomes of *Sium longifolium*, *Asclepias Vincetoxicum*, and *Veratrum album*. The rhizome of *Sium longifolium* is lighter in colour, and its rootlets are very wrinkled ; that of *Asclepias Vincetoxicum* is very knotty, and furnished with tufts of pale roots at intervals, whilst that of *Veratrum album* is larger, with crowded leaf bases on the upper portion.

Therapeutics.—Nervine stimulant.

Official Preparations.—*Infusum Valerianæ* ; *Tinctura Valerianæ* ; and *Tinctura Valerianæ Co.*

COMPOSITÆ.**No. 119. Pyrethri Radix. Pellitory Root.**

The dried root of *Anacyclus Pyrethrum*.

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Habitat.—The plant is a native of the north-west of Africa, and is principally exported from Algeria and Tunis to Marseilles and other French ports.

Characters.—The root as found in commerce is in unbranched, cylindrical pieces, from 2 to 4 inches in length, somewhat tapering towards the apex. It is covered with a thick, shrivelled, brown-coloured bark, marked with irregular circles of resin cells. It breaks with a short fracture, and the fractured surface presents a fine radiate structure. It is inodorous; but when chewed it has an aromatic acrid taste, producing at the same time a pricking sensation of the throat with glowing heat.

Insect powder consists chiefly of the dried and powdered flower heads of different species of *Pyrethrum*, more particularly *P. cinerarifolium* and *P. roseum*.

Composition.—Pellitory root contains, according to Buchheim, a peculiar alkaloid, pyrethrine, a resin, and small traces of a volatile oil. The substance called pyrethreine consists of a mixture of resin and two fatty oils. The alkaloid pyrethrine is said to yield pyrethric acid when treated with caustic potash.

Substitute.—The root of *Anacyclus officinarum* yields the German pellitory root. It is closely related to the official drug in all its characters, except thickness, being only about half the size, and furnished with numerous rootlets, and, if anything, a shade lighter in colour.

Therapeutics.—Sialogogue.

Official Preparation.—*Tinctura Pyrethri*.

No. 120. Santonica. *Santonica*.

The dried unexpanded flower-heads or capitula of *Artemisia maritima*, var. *Stechmanniana*.

Habitat.—The plant is largely cultivated on the steppes of Turkestan, from which it seems to be mainly obtained; it is sent to Nishnei Novgorod, and from thence distributed to other countries.

Compositæ.

Characters.—Santonica or Levant wormseed consists of the unexpanded minute capitula, about one-tenth of an inch in length, oblong ovoid, obtuse, pale greyish-green, changing to brownish-green on exposure to light. The involucre is composed of twelve or more scales, densely imbricated, enclosing three or five small undeveloped tubular florets. Odour strong and peculiar, slightly camphoraceous, taste bitter and unpleasant. There are several varieties of wormseed, but only the Levant or Russian is official.

1. Levant or Russian Wormseed, from *A. maritima*, var. *Stechmanniana*.

2. Barbary Wormseed, from *A. ramosa*.

3. Indian Wormseed, from *A. species*.

4. American Wormseed, from *Chenopodium ambrosioides*.

The last is not met with in European commerce, but has been found as an adulteration in American. It consists of the fruit, and bears no resemblance whatever to Santonica. The Barbary and Indian varieties contain little or no santonin, and they usually present a hairy appearance.

Composition.—Wormseed contains about 2 per cent. of a peculiar body santonin, resin, and about 2 per cent. of a volatile oil, to which the odour of the drug is due.

Santonin, $C_{15}H_{18}O_3$. This substance is the anhydride of Santonic Acid, $C_{15}H_{20}O_4$, and is readily extracted by boiling the capitula with milk of lime or caustic soda. Dragendorff's method for the estimation of Santonin is as follows: Weigh 15 grams, digest for two hours with a 10 per cent. solution of caustic soda, using 15cc., dilute to 200cc. with water, then filter and wash. Evaporate the filtrate and washings to 40cc., cool and neutralise with hydrochloric acid, and filter immediately, wash the precipitate with a few cc. of weak soda solution; acidify the filtrate with hydrochloric acid, and agitate repeatedly with different portions of chloroform. Mix the chloroformic solutions, and wash by agitation with water, then carefully evaporate, and weigh. Santonin forms colourless tabular crystals, and on exposure to sunlight is altered into photosantonin, $C_{23}H_{34}O_6$, which is more soluble. When heated

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in a stream of hydrogen with zinc dust it yields Santonol, $C_{15}H_{18}O$, and when dissolved in alkalies forms santonic acid, and the salts when shaken with hydrochloric acid and ether, yield to the latter santonic acid, $C_{15}H_{20}O_4$. If its solution in strong sulphuric acid be heated and a drop of a dilute solution of ferric chloride added, it assumes a red tinge changing to violet and then brown.

The Volatile Oil consists of hydrocarbons, of which cineol is the principal constituent; this body is identical with cajeputol and eucalyptol; it also contains a neutral hydrocarbon cinene.

Adulteration of Santonine. Santonine is sometimes met with containing boracic acid; this is readily detected by the glassy residue left on incineration, and by the green colour it imparts to the flame. Strychnine has, on more than one occasion, been mistaken for santonine; it may be distinguished by its intense bitterness, insolubility in alkalies, and by the violet coloration with sulphuric acid and potassium bichromate.

Test.—Santonine dissolved in strong sulphuric acid, and then diluted with water, on filtering should not give any precipitate on the addition of Mayer's reagent, proving absence of alkaloids.

Therapeutics.—Anthelmintic.

Official Preparation.—Santoninum.

No. 121. Anthemidis Flores. Chamomile Flowers.

The dried single and double flower-heads or capitula of *Anthemis nobilis*, collected from cultivated plants.

Habitat.—Indigenous to Central and Southern Europe, including England and Ireland. Cultivated chiefly in Germany, Belgium, France, and Britain.

Characters.—The single chamomile flowers are those in which the capitula have a single row of white ligulate florets of the ray, surrounding a large number of the yellow tubular florets of the disc, they are not frequently met with

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in commerce; the double flowers are those in which all or nearly all the yellow tubular florets of the disc have, by cultivation, become changed into the white ligulate florets. What are known in English commerce as single chamomiles are really double, but have a few single florets in the centre. The truly single ones are known as Scotch chamomiles. Chamomile flowers of both varieties have a solid, conical receptacle, densely covered with numerous imbricated scales having a scarious margin; the white ligulate florets are tridentate and pistillate, while the yellow tubular florets are quinquedentate, hermaphrodite, being exserted with a forked stigma, the style branched. The flowers possess a peculiar strong aromatic odour and persistent bitter taste, more prominent in the single flowers.

Composition.—Chamomile flowers contain an essential oil, a bitter principle (anthemic acid), resin, tannin, and chlorophyll.

The Essential Oil, which is prepared by distillation, is obtained to the extent of .5 per cent., and when prepared from the fresh flowers is of a blue colour, which changes on keeping to green and then yellow; the dried flowers yield a greenish-yellow oil. The oil consists of angelic, tiglic, and isobutyric acids, a camphor anthemol, the acids existing as ethereal salts of isobutyl, amyl, and hexyl alcohols (Koebig). The principal constituents are angelic and tiglic acids, which are isolated by saponifying the oil with caustic potash, distilling to separate the alcohols, and separating the acids by addition of dilute sulphuric acid; the acids may then be separated by fractional distillation, or by converting them into calcium salts, and separating the calcium tiglate with hot water. Angelic acid, $C_5H_8O_2$, is easily converted into its isomer tiglic acid by prolonged gentle ebullition (Demarçay). The oil contains nearly 30 per cent. of these acids; it does not combine with acid sodium sulphite, and has a specific gravity of .90. The oil is generally prepared from the entire plant after most of the flowers have been removed.

Anthemic Acid. This, the reputed bitter principle of chamomile flowers, can be removed by simple maceration in

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ether, and on evaporation is left in an impure state as a soft extract. Naudin extracted from the flowers with petroleum spirit, two crystallisable bodies which he separated by treatment with absolute alcohol; the insoluble compound he terms anthemen, and ascribes to it the formula of $C_{16}H_{36}$.

Adulteration.—The capitula of several *Compositæ* have been found as an occasional adulteration, amongst them being those of *Pyrethrum Partienium* or Feverfew, and *Matricaria Chamomilla*; the former are distinguished by their flat and nearly naked receptacles, and the latter by the hollow conical receptacles devoid of scales.

Therapeutics.—Aromatic tonic.

Official Preparations.—*Extractum Anthemidis*; *Infusum Anthemidis*; and *Oleum Anthemidis*.

No. 122. *Taraxaci Radix.* Dandelion root.

The fresh and dried roots of *Taraxacum officinale* (*Taraxacum Dens-leonis*), gathered in the autumn.

Habitat.—Indigenous throughout Europe, North America, and Central and Northern Asia.

Characters.—The root, when fresh, is from 6 to 18 inches in length and about half an inch in diameter, nearly cylindrical, simple or slightly branched, and crowned with a few small heads. Externally it is smooth and of a yellowish-brown colour; white within. The root is brittle, and fleshy, and when broken a milky juice exudes. The dried root is wrinkled longitudinally, dark coffee-brown colour externally, and much shrivelled; fracture short, showing a yellow porous central woody axis, surrounded by a thick whitish bark having a number of concentric rings; taste bitter. When exposed to a damp atmosphere it absorbs moisture and becomes slightly flexible. The juice increases in density and bitterness during autumn, and yields a better extract than from roots collected at any other season. The root is frequently attacked by maggots, and should not be kept more than one season.

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Composition.—Dandelion root yields a milky juice, from which Kromayer extracted a bitter principle, taraxacin, and an acrid resin. The composition of this root varies considerably, according to the season in which it is collected; during the spring it contains notable quantities of an uncrystallisable sugar and lævulose, with only minute quantities of inulin; during the autumn it contains only traces of sugar, but in place of it Dragendorff found 24 per cent. of inulin. The juice obtained during the autumn undergoes a kind of fermentation, and amongst the products formed, Messrs. T. and H. Smith found a considerable quantity of mannite sugar. When the juice is boiled with water and concentrated, then allowed to slowly evaporate, it deposits crystals of taraxacin (Pollex).

Substitution.—The root of *Leontodon hispidus*, Hawkbit, is sometimes supplied in place of dandelion; it contains very little if any juice and is extremely tough.

Therapeutics.—An alterative in liver complaints.

Official Preparations.—Decoctum Taraxaci; Extractum Taraxaci; Extractum Taraxaci Liquidum; and Succus Taraxaci.

No. 123. Arnicæ Rhizoma. *Arnica Rhizome.*

Synonym :—*Arnica Radix.*

The dried rhizome and rootlets of *Arnica montana*.

Habitat.—Indigenous to the mountainous parts of Central Europe and Northern Asia; it is also found in the northern districts of America.

Characters.—The rhizome is thin, contorted, cylindrical, from 1 to 3 inches in length and about a quarter of an inch in diameter, and rough from the scars of fallen leaves; a few leaves are sometimes attached at its upper end, and have a coriaceous texture; on the under surface of the rhizome numerous dark brown, fine, thread-like rootlets are given off. In colour the rhizome is dark brown externally, white internally, with a circle of yellow resin.

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cells. This same character is evident on examining a transverse section of the rootlets. Odour slightly aromatic and peculiar; taste persistently acrid and bitter. The rhizome is collected during the spring. Before being used, adherent leaves should be removed.

Composition.—Arnica rhizome contains a peculiar essential oil and a principle, arnicin, with small quantities of gum and wax.

The Essential Oil obtained from the dried rhizome by Sigel amounted to .5 per cent. ; he found it to consist principally of the dimethyl ether of thymohydroquinone. The water, after separation of the essential oil, contains traces of angelic, isobutyric, and formic acids.

Arnicine, an alkaloid, has been isolated by Bastick from the flower. Walz extracted a body named arnicin. The latter may be obtained as a yellow mass of acrid taste by exhausting the rhizome or flowers with alcohol, decolourising the tincture, carefully evaporating to dryness, and dissolving it out from the residue with ether. It is soluble in alkalies, and precipitated from its solution in alcohol by tannin or water.

Inulin was obtained from the rhizome by Dragendorff to the extent of 10 per cent.

Adulteration.—The roots of various Composites are occasionally substituted, and latterly the astringent root of *Geum urbanum*, but there is little difficulty in detecting the fraud, as the latter is a root, and has a purplish medullium.

Therapeutics.—Used externally for bruises, internally in paralysis.

Official Preparation.—Tinctura Arnicæ.

No. 123. Arnicæ Flores. Arnica Flowers.

The flowers are frequently used in place of the rhizome, particularly on the Continent. The capitula are large and handsome, of a bright yellow colour. The involucre consists of two rows of hairy scales, which are imbricated ;

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the receptacle is covered with a number of chaffy scales ; the ligulate ray florets are about one inch in length ; tubular perfect florets numerous. Prior to use, the florets should be removed from the receptacle.

Adulteration.—Other yellow Composite flowers are sometimes met with, including those of *Inula britannica*, *Senecio*, and *Calendula* ; the last are most easily recognised by the absence of pappus and the naked receptacle.

No. 124. *Lactuca.* *Lettuce.*

The flowering herb of *Lactuca virosa*.

Habitat.—Indigenous to Western and Southern Europe, and this country.

Characters.—Prickly Lettuce is a biennial herb, growing to a height of from 3 to 6 feet ; the stem is cylindrical, pale green with a few purplish spots, and prickly near its base. The stem leaves are smaller than the radical leaves, and are slightly amplexicaul at the base, with an acute apex, and are sessile ; both leaves are of a pale green colour, ovate oblong, the midrib prickly and white. The slender capitula are generally situated on short axillary peduncles, and are of a pale yellow colour. The entire plant has a peculiar disagreeable narcotic odour, and bitter taste, and abounds in a milky juice.

Composition.—No modern analysis of the plant has been made, chemists devoting their investigation solely to *lactucarium*.

Therapeutics.—Hypnotic and sedative.

Official Preparation.—*Extractum Lactucæ.*

No. 125. *Lactucarium.* *Lactucarium.*

(*Not official.*)

Synonym :—*Lettuce Opium.*

The inspissated latex or milk-juice obtained from *Lactuca virosa*, *L. Scariola*, *L. altissima*, and *L. sativa*.

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Habitat.—Lactucarium is principally collected in Germany and Great Britain.

Secretion and Collection.—The stem has two systems of laticiferous vessels, separated by an intervening zone of wood; the outer system is formed in the bark and the inner system in the pith. The collection commences in July, the collector cutting off the apex of the stem, and the milky juice, which instantly exudes, is scraped off into earthen vessels, the process being repeated several times during the day on the same plant. In Germany the juice is collected by the finger. After collection it quickly hardens, and is then transferred from the vessels and cut into square masses, and finally dried by exposure to sunshine or artificial heat, acquiring a light brown colour externally.

Therapeutics.—Hypnotic and sedative.

Characters.—Lactucarium is met with in irregular angular, earthy-like masses, or in small circular cakes, externally greyish-brown or reddish-brown, internally of a lighter colour, opaque, and sometimes presents a waxy appearance. It has a marked disagreeable, opiate odour, and bitter taste. The powder is not readily miscible with water.

Composition.—Lactucarium is a complex mixture of organic bodies, and about 10 per cent. of inorganic matter. The principal constituents are lactucon or lactucerin, lactucin, lactucic acid, and lactucopirine.

Lactucon or *Lactucerin* ($C_{16}H_{26}O$) is obtained by exhausting the drug with boiling alcohol, from which it crystallises on cooling, in fine needles. It is readily soluble in ether, and oils, both fixed and volatile, and chloroform; insoluble in water. It constitutes about 60 per cent. by weight of the drug.

Lactucin ($C_{11}H_{12}O_3, H_2O$) is only present in small quantities, under 1 per cent., and is one of the bitter principles of lactucarium; it is readily soluble in cold alcohol and boiling water, from which it crystallises in pearly scales. Alkalies destroy its bitter taste, and its aqueous solution reduces Fehling's solution.

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Lactucopierine and Lactucic acid, the two other bitter principles, are left in the mother liquor. Lactucarium also contains small quantities of organic acids and asparagin.

Test.—When treated with boiling water lactucarium should become soft, the filtrate should have a bitter taste, and on cooling no blue colour ought to be produced on addition of iodine solution. The cooled filtrate becomes muddy, but is cleared on addition of solution of ammonia, and this, on addition of calcic chloride, should give a copious precipitate (presence of oxalic acid).

No. 126. Inulæ Radix. Elecampane.

(*Not official.*)

The dried root of *Inula Helenium*, entire or split longitudinally.

Habitat.—Indigenous to Central and Southern Europe, and found in some districts in England. It is cultivated in England and Holland.

Characters.—The root is about 6 inches long, and branched below; thick, fleshy, the branches being about $1\frac{1}{2}$ inch in diameter; externally marked irregularly, and of a greyish-brown colour; internally white and juicy when fresh, grey after drying, with a strong aromatic camphoraceous odour, and bitter taste. In commerce the thicker roots are sliced longitudinally, and frequently strung on a thin cord, and become flexible if kept in a damp place.

Composition.—Elecampane contains alant camphor, an essential oil, inulin, resin, and a bitter principle. An alcoholic extract, when diluted with water, deposits crystals of helenin (Kallon). The essential oil obtained by steam distillation yields alant camphor ($C_{16}H_{16}O$), and alantol or inulol. The crystals that are sometimes found on the surface of roots that have been long kept are the anhydride of alantic acid ($C_{15}H_{20}O_2$). This can easily be extracted from the root by spirit, and precipitated by water.

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Inulin, $C_6H_{10}O_5$. This starch, which is so characteristic of the roots of composite plants, is found in variable quantities. In autumn the roots contain about 40 per cent. by weight of inulin. It is nearly insoluble in cold water, but is largely dissolved on boiling, becoming slightly altered. On hydrolysis it yields lævulose, and gives a yellow colour with iodine.

LOBELIACEÆ.

No. 127. *Lobelia*. *Lobelia*. *Indian Tobacco*.

The dried flowering herb of *Lobelia inflata*.

Habitat.—Indigenous to the North American Continent.

Characters.—The herb grows to a height of about 2 feet, the primary axis throwing off a number of slender branches. The leaves are 1 to 3 inches long, alternate, ovate, oblong, faintly toothed, pale green, pubescent, and are situated principally on the middle and lower portions of the axis. The upper ones are sessile, whilst the lower have short petioles. The small flowers are in long racemes at the apex of the stem and branches, calyx persistent, corolla bilabiate, and pale blue. The fruit is a small round capsule, bilocular, each loculus containing a number of small seeds, having a finely reticulated and pitted testa. Odour herbaceous and irritating; taste at first mild, afterwards burning and acrid, like tobacco. As met with in commerce it is in flat or circular compressed cakes, of a yellowish-green colour, weighing from half a pound to a pound each, wrapped in coloured paper and sealed.

Composition.—*Lobelia* contains a liquid alkaloid lobeline, an essential oil, and an acrid resin lobelacrin.

Lobeline is a yellow liquid volatile alkaloid, which is readily obtained by exhausting the drug with alcohol of sp. gr. .838 containing 10 per cent. of tartaric acid, recovering the alcohol by distillation, adding to the soft extract a little milk of lime, transferring to a retort and distilling. The distillate contains a considerable amount of ammonia as well as

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lobeline. The latter is removed by twice agitating the liquid with petroleum ether, separating the ethereal layer, and carefully evaporating off the ether with a current of warm air. The alkaloid can be purified by first converting it into hydrochlorate, and then distilling from magnesium oxide. It is sparingly soluble in water, imparting to the solution a pungent tobacco-like taste. It is readily soluble in ether, alcohol, fixed oils, and benzene. It neutralises acids, forming crystallisable salts, which are easily soluble in water and alcohol; insoluble, or nearly so, in ether. It readily decomposes on exposure to light, becoming dark coloured and resinous. A crystalline alkaloid, soluble in chloroform, but only with difficulty in water, has recently been detected by Herr von Rosen. According to Lloyd, lobeline is not a volatile alkaloid.

Lobelacrin.—This is the acrid principle of lobelia, and was isolated by Enders; an alcoholic tincture is evaporated to dryness in the presence of charcoal, which fixes the lobelacrin. This is then washed with water, and exhausted with boiling spirit, which on evaporation yields an extractiform mass, which is purified by chloroform, in which it is readily soluble. When hydrolised by dilute acids or alkalies it yields lobelic acid and glucose. Lobelic acid can also be prepared from the decoction of the herb by adding sulphate of copper, when lobelate of copper is precipitated, from which lobelic acid may be separated by sulphydric acid, and can be subsequently purified. A recent examination has shown that lobelacrin consists of a mixture of inflatin, lobeline, oil, and resin.

The Essential Oil is only found in minute quantities, and has been supposed to be identical with the Lobelianin of Pereira.

Proctor has obtained from the seeds about 30 per cent. of a quick-drying, fixed oil.

Therapeutics.—Antispasmodic and expectorant.

Official Preparations.—Tinctura Lobeliæ and Tinctura Lobeliæ Ætherea.

ERICACEÆ.

No. 128. *Uva-Ursi Folia.* *Bearberry Leaves.*

The dried leaves of *Arctostaphylos Uvæ-ursi* (*Arbutus Uvæ-ursi*).

Habitat.—The bearberry is a trailing evergreen shrub, found in northern latitudes. It is found in Northern Europe, North America, and Northern Asia; also throughout Scotland, in the north of Ireland, and in the northern counties of England.

Characters.—Bearberry leaves are almost sessile, spatulate, or obovate, coriaceous, about half an inch long; apex obtuse, margin entire and somewhat revolute; upper surface smooth and shiny, under-surface pale green, and finely reticulated. Odour hay-like, more pronounced on powdering; taste faintly bitter, and strongly astringent. The plant bears short pendulous racemes of white urceolate flowers, and bright red drupaceous fruits, which ripen in September, at which time the leaves should be collected.

Composition.—Bearberry leaves contain about 35 per cent. of tannic acid, traces of gallic acid, and a characteristic principle arbutin, and its methyl derivative, also ericolin and ursone.

The tannic acid present gives a bluish-black precipitate with a neutral solution of ferric chloride. Bowman estimated it, and gave, according to the gelatine process, nearly 7 per cent., but the method is altogether unsatisfactory.

Arbutin, $C_{25}H_{34}O_{14}$, is the glucoside of hydroquinone. It is best prepared by concentrating a decoction of the leaves, and precipitating tannin and colouring matters with basic plumbic acetate, filtering and removing excess of lead with sulphydric acid, again filtering and rapidly evaporating, when the arbutin separates on cooling in a crude condition. Dalmon terms this crude product arbutose, as it contains nearly 40 per cent. of glucose. It is purified by dissolving in alcohol, and then removing the alcohol by distillation. Various formulæ have been ascribed to arbutin; Schiff and

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Michael state that two different arbutins occur in nature, viz., $C_{12}H_{16}O_7$, and methyl-arbutin, $C_{13}H_{18}O_7$, but the formula of Hlasiwetz and Habermann, $C_{25}H_{34}O_{14}$, seems the most correct. Arbutin crystallises in white shiny crystals, very soluble in water, sparingly in alcohol, and almost insoluble in ether. Its aqueous solution has a bitter taste, and on hydrolysis yields hydroquinon, $C_6H_4(OH)_2$, methyl-hydroquinon, $C_6H_4(OCH_3)(OH)$, and glucose. When oxidised with manganic oxide and sulphuric acid it yields quinone, recognised by its iodine-like odour; its aqueous solution, on addition of ammonia, and then phosphomolybdic acid, acquires a fine blue colour; nitric acid converts it into tetra-nitro-arbutin, $C_{25}H_{30}(NO_2)_4O_{14}$.

Ericolin, $C_{34}H_{56}O_{21}$. This bitter principle is left in the mother liquor after separation of arbutin, from which it is obtained on evaporation. It is an intensely bitter substance found in most plants of this order; it is a yellow amorphous mass, yielding on decomposition with dilute sulphuric acid, ericinol, $C_{10}H_{16}O$, an oily body, which rapidly resinifies.

Ursone, $C_{20}H_{32}O_2$, is obtained from an alcoholic extract after it has been submitted to repeated treatments with water and ether. The extract is then treated with boiling spirit, from which ursone crystallises in silky needles (Trommsdorff).

Adulteration.—The leaves of the following plants are occasionally confounded with those of bearberry:—

(a.) *Buxus sempervirens*. Box Leaves are broader and larger, pale green colour, narrower towards the apex, ovate in form, only faintly astringent, and intensely bitter.

(b.) *Vaccinium Vitis-Idææ*. Cowberry or Red Whortleberry. They have a finely crenate margin, the apex reticulated, and are dotted on the under surface; the margin is more revolute.

(c.) *Vaccinium uliginosum*. Bog Bilberry. They are pubescent on the under surface, pale green in colour, and are not coriaceous.

Therapeutics.—Astringent.

Official Preparation.—Infusum Uvæ Ursi.

SAPOTACEÆ.

No. 129. Gutta-Percha. *Gutta-Percha*.

Synonym:—Gutta Taban.

The concrete milky juice obtained from incisions in the trunk of *Dichopsis Gutta* (*Isonandra Gutta*), and of several other trees of this natural order, including other species of *Dichopsis*, *Ceratophorus* and *Payena*.

Habitat.—The Taban tree and the other members of the genus are all indigenous to Southern India, Ceylon, Sumatra, Borneo, and the Malayan Archipelago.

Collection.—The taban or gutta-percha tree grows to a height of sixty to seventy feet, bearing numerous thick glossy entire leaves which have a coriaceous texture. The inner bark and young wood contain a considerable quantity of latex. The older method of collection, practised in Singapore, was to fell the tree and then make a series of incisions, when the latex exuded, and rapidly hardened, after which it was removed. This method had most disastrous results, in a short time the tree became extinct in Singapore. It is now collected in Borneo and other islands by tapping the trees and collecting the hardened latex. By this means as much as 20 lbs. have been obtained from one tree.

Characters.—Raw gutta-percha arrives in this country in large roundish masses, weighing about six pounds. In this condition it is first softened with boiling water; and then torn into fine shreds by revolving cylinders covered with sharp teeth, and thrown into tanks of cold water, the shreds are collected, treated with warm water, and then kneaded by machinery into masses. Prepared gutta-percha occurs in pieces of a greyish, yellowish, or reddish-brown colour; leathery or horny, tough, flexible, and plastic above 120° F., and very soft at 212° F. It is insoluble in water, alkaline solutions, dilute acids, or alcohol; soluble in chloroform, terebenthene, benzol, carbon disulphide, and coal tar oils. It is obtained as a white mass by treatment with dilute hydrochloric acid, and then repeated solutions in ether or chloroform.

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Composition.—Gutta-percha consists almost entirely of a hydrocarbon, having the formula $C_5 H_8$. Baumhauer gives $C_{20} H_{32}$, probably the composition of the original latex. Commercial gutta-percha contains two oxidised compounds of the pure gutta, viz., fluavil, $C_{20} H_{32} O_2$, and albane, $C_{20} H_{32} O$.

Allied Products.—India-rubber or caoutchouc is an elastic gummy substance, which consists of the inspissated juice of different plants, the subjoined being the more important.

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|--------------------------|---------------|------------------|
| 1. Ficus Elastica. | Moraceæ. | Assam. |
| 2. Castilloa Elastica. | Artocarpaceæ. | Central America. |
| 3. Hevea Braziliensis. | Euphorbiaceæ. | Brazil. |
| 4. Landolphia species. | Apocynaceæ. | Africa. |
| 5. Willoughbeia species. | Apocynaceæ. | Borneo. |
| 6. Sapota Mulleri. | Sapotaceæ. | British Guiana. |

Official Preparation.—Liquor Gutta-Percha.

STYRACEÆ.**No. 130. Benzoinum. Benzoin.**

A balsamic resin obtained from *Styrax Benzoin*, and probably from one or more species of *Styrax*.

Habitat.—The benzoin trees are indigenous to Siam, Sumatra, Borneo, Cochin China, and Java.

Collection.—When the tree is about six years old and has attained a diameter of three feet, it can be bled. The natives wait until the leaves wither and fall off, they then make a number of deep incisions into the bark, when a milky, resinous liquid exudes which soon hardens and falls to the ground, or is removed. In commerce there are four varieties of Benzoin, viz.:—Sumatra, Siam, Penang, and Palembang. They can be readily recognised from one another by the following characteristics.

Characters.—Sumatra Benzoin is met with in commerce in cubic blocks weighing from 1 to 2 cwt., which, when broken, present a granitoid appearance, generally of

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a grey colour. The mass is made up of numerous tears of a milk white colour, sometimes very small, and imbedded in a brown-coloured resin. The broken surface rarely presents a distinct amygdaloid appearance; in inferior benzoin the tears are entirely absent and the mass is of a darker colour, and sometimes consisting principally of small pieces of bark. Odour fragrant and agreeable, but not nearly so marked as the Siam benzoin. Penang Benzoin is identical in appearance with the Sumatra drug, principally differing in odour, which is decidedly different from that of Siam or Sumatra benzoin, and resembles that of liquid Storax. Palembang Benzoin closely resembles the Sumatra kind in odour, but differs principally in its greater transparency. Its alcoholic solution gives a flaky precipitate with water (Saalfeld). It is said to yield a greater percentage of benzoic acid. Siam Benzoin. This is the most esteemed kind of benzoin. It frequently occurs in large, flattish tears, or in loose masses of tears agglutinated together with a clear brown resin, or it may consist entirely of the resin. The mass presents a reddish-brown granitoid appearance. Odour is agreeably balsamic, and slightly resembles vanilla; the tears when fractured present a stratified appearance, the milky white surface becoming brown on exposure to the air.

Benzoin is brittle and readily softens when held in the mouth; it gives off, when heated, the fumes of benzoic acid; it should be almost entirely soluble in six times its weight of alcohol. It is principally shipped from the ports of Penang, Bangkok, and Singapore. According to the quality it is known under the different terms Head, Belly, and Foot, Oriental terms synonymous with superior, medium, and inferior.

Composition.—Benzoin contains several resins, benzoic acid, and essential oil. Vanillin and cinnamic acid have also been found in some samples.

The Resins:—are only partially soluble in ether, but entirely soluble in caustic potash solution, or strong alcohol. They appear to be closely correlated to one another, and to possess faintly acid properties; occasionally

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they are termed alpha-resin and beta-resin. When fused with solid caustic potash they yield pyrocatechin, $C_6H_4(OH)_2$, para-oxybenzoic acid, $C_6H_4OH COOH$, and proto-catechuic acid, $C_6H_3(OH)_2 COOH$, as well as small quantities of benzoic and salicylic acids; on dry distillation they yield a highly empyreumatic benzoic acid and cinnamene.

Benzoic Acid, C_6H_5COOH . This acid is prepared either by the wet method or by sublimation: the former method yields a purer and almost odourless acid. Wet method:—Finely powdered benzoin is mixed with an equal weight of calcium hydrate and ten times its weight of water, the mixture is boiled slowly for some time and then filtered, the residue is washed with boiling water, the washings mixed with the filtrate and evaporated to one fourth of the original bulk, and when cold acidulated with strong hydrochloric acid, the precipitated benzoic acid is collected on a filter, re-dissolved in boiling water, agitated with charcoal, filtered and carefully evaporated, the crystals are dried between folds of bibulous paper and dissolved in a small quantity of ether, and set aside to crystallise. By this method the amount of benzoic acid existing naturally in benzoin can be estimated. From a number of samples recently examined by this process as much as 21 per cent. has been obtained, and the average of six estimations of Sumatra benzoin gave 17·8 per cent., but the acid was not examined for cinnamic acid, which occasionally accompanies benzoic acid, particularly in Siam and Penang benzoins. Benzoic acid, when prepared by sublimation, is mixed with its own weight of pumice stone or sand. On the large scale, it is heated and condensed in a chamber. On cooling, the benzoic acid condenses in shining needles having an aromatic and fragrant odour.

Benzoic acid is prepared on a large scale from coal tar products, *e.g.*: naphthalin and toluene, and also hippuric acid or benzoyl-glycocine, a substance found in the urine of all herbivorous Mammalia. Benzoyl-glycocine, $CH_2(NH C_6H_5 CO)COOH$, on treatment with acids or alkalies yields benzoic acid and glycocine or amidoacetic acid, the former of which can be obtained in long needles by sublimation. Benzoic

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acid is dimorphic ; the crystals melt at 120° C., and boil at 250° C. It is soluble in 200 parts of cold and 24 parts of boiling water ; readily soluble in alcohol, ether, benzene, and oils.

Cinnamic Acid, C_8H_7COOH , is found in certain benzoin, and from Sumatra benzoin, Aschoff isolated 11 per cent. It melts at 133° C., boils at 290° C., and is with difficulty dissolved by cold water. On gentle oxidation with acidulated solution of potassium permanganate it yields carbon dioxide and benzaldehyd, C_6H_5CHO .

Vanilline, $C_6H_3(OH)(OCH_3)CHO$, has been found in small quantities, and appears to be more characteristic of Siam benzoin.

The Essential Oil is only obtained in very small quantities, by steam distillation, is agreeably aromatic and fragrant, and has been named styrol, but it differs from true styrol.

The fine tears of benzoin do not contain so much benzoic acid as the red coloured resin ; they are principally purchased by the Greeks and Russians for use as incense.

Therapeutics.—Expectorant.

Official Preparations.—Acidum Benzoicum ; Adeps Benzoatus ; Tinctura Benzoini Co. ; and Unguentum Cetacei.

OLEACEÆ.**No. 131. Manna. *Manna.***

A concrete saccharine exudation obtained by making transverse incisions in the stems of cultivated trees of *Fraxinus Ornus* (*Ornus Europea*).

Habitat.—The Manna, or Flowering Ash, is indigenous to countries bordering the Mediterranean, and the islands of Sardinia, Corsica, and Sicily. It is also cultivated in Italy.

Collection.—When the tree has attained an age of eight or ten years, a horizontal incision is made to one-fifth of its circumference with a sharp knife. The incisions are first made on the side to which the tree inclines ; from day to day a fresh incision is made until the branches are reached.

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The juice which flows from the incision is at first brownish, but on exposure to the air it becomes solid, whitish, and sweet, forming long stalactitic pieces. When the juice is very thin it is collected upon the leaves of *Ficus Indica*. It is collected once a week, and only in fine weather, the chief time being from July to September. A tree will yield manna for nine or ten years, after which it is removed and a young shoot planted in its place. The above description is that given by Janssen.

Characters.—Manna of commerce has various names applied to it, *e.g.*, large flake, small flake, and sorts. Flake manna consists of stalactitic pieces varying in length and thickness, flat or concave on the inner surface, where it adhered to the tree, of a pale yellowish-brown or yellowish-white colour externally; it is friable, internally porous, and exhibits small cavities filled with minute crystals of mannite. Odour saccharine; taste sweet and honey-like, with a faint bitterness and acidity. Manna in sorts is made up of the scrapings and droppings, and is met with in small pieces, with an adhesive brown-coloured surface, internally crystalline and whitish; it contains less mannite and more gum than the flaky sort. Manna is soluble in six parts of water, forming a clear faintly coloured solution. It yields to boiling alcohol about four-fifths its weight.

Composition.—Manna contains mannite as the chief component, with small quantities of sugar, resin, and gum, and about 9 to 12 per cent. of moisture.

Mannite, $C_6H_8(OH)_6$. This hexatomic alcohol is the chief constituent of manna, and various qualities have yielded from 55 to 85 per cent.

Estimation of Mannite.—Weigh 10 grams of cut manna into a tared dish, and place it in an air oven having a temperature of 160° F. until it ceases to lose weight, then transfer to a desiccator until cold, and weigh; the loss multiplied by 10 will give the percentage of moisture; now transfer the dried manna to a flask, and boil with successive portions of alcohol of sp. gr. $\cdot 838$, until 80 cc. have been used; mix the liquids, and carefully evaporate on a water-

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bath to one-third, after which, on cooling, the mannite crystallises out ; dry and weigh ; the amount multiplied by 10 will give the percentage of mannite. Flake manna treated in this way yielded 85 per cent. of mannite.

Mannite can be prepared artificially by the action of nascent hydrogen, obtained from sodium amalgam, on dextrose or levulose. It is soluble in six parts of water, sparingly in alcohol, and insoluble in ether. Oxidised by platinum black, it gives mannitic acid $C_6H_{12}O_7$, and mannitose $C_6H_7(OH)_5O$, its aldehyd. Nitric acid converts it into saccharic and mucic acids. It undergoes fermentation slowly (Berthelot) ; but when kept in contact with chalk or putrid cheese it yields acetic, lactic, and butyric acids (Strecker).

The sugar present in manna quickly reduces Fehling's solution, and consists of levulose and saccharose (Buignet). The resin can be extracted from manna by agitation with ether ; it is a reddish-brown substance, with a disagreeable odour and slightly acrid taste. Occasionally manna possesses a faint green colour, due to minute traces of a peculiar substance found chiefly in the bark, viz., fraxin, whose solution has a green fluorescence ; it is a glucoside, and decomposes into fraxetin and glucose.

Adulteration.—Manna is rarely subject to sophistication, but a spurious article has been made of inferior manna worked up with gum or sugar ; a sample recently examined was characterised by its snow-white appearance and sparing solubility in alcohol ; on further examination it was found to consist of glucose with a small admixture of gum.

Varieties of Manna.—There are numerous other trees that yield saccharine exudations known as manna, of which the following are the principal :—

Briançon Manna,	from Pinus Larix.
Armenian Oak Manna,	„ Quercus Vallonea and Q. Persica.
Australian Manna,	„ Eucalyptus viminalis.
Tamarisk Manna,	„ Tamarix gallica, var. mannifera.
Persian Manna,	„ Alhagi Camelorum.

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Cotoneaster Manna, from *Cotoneaster nummularia*.
Lebanon Manna, „ *Cedrus Libanotica*.

Therapeutics.—Laxative.

No. 132. Oleum Olivæ. Olive Oil.

Synonym:—*Sweet Oil*.

A fixed oil expressed from the ripe fruit of *Olea Europæa*.

Habitat.—Indigenous to Western Asia and countries bordering on the Mediterranean; largely cultivated in Italy.

Preparation.—The fruit of the olive is an oval drupe, about an inch long, and of a dark purple colour when ripe; the sarcocarp contains a large amount of fatty oil, amounting to nearly four-fifths of its weight. Virgin or finest olive oil is obtained by gently pressing the fruit; the oil which oozes out is collected in cisterns containing water, from which it is removed by skimming; it is of a light amber-yellow colour and pleasant flavour. A second quality of oil is obtained by stronger pressure of the marc mixed with boiling water. An inferior oil is obtained from fruit allowed to ferment in heaps. This is known as “Huile fermentée.”

Olive oil is imported in barrels, in stone vessels, and in bottles. Tuscan oil, especially that from Lucca, is considered the best. Various methods are employed to decolorise the dark oils; nitric or sulphuric acids, or the alkalies ammonia or soda are employed, or solution of potassium permanganate, and filtration through kaolin.

Characters.—Olive oil is a pale yellow or greenish-yellow oily liquid, with a faint agreeable odour, and a bland oleaginous taste, becoming slightly acrid. Its specific gravity at 60° F. is between .915 and .918; it congeals partially at 36° F. into a butyraceous consistency, but becomes quite solid at 26° F. It is soluble in ether, chloroform, carbon bisulphide, and sparingly in alcohol; it becomes nearly colourless on heating, and finally boils at 600° F.

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Composition.—The fluid portion of olive oil consists of triolein, and the solids (of which about 30 per cent. may be separated by pressure from the congealed oil) of tripalmitin, triarachin, and possibly tristearin, with a minute quantity of cholesterin.

Triolein, $C_3H_5 (C_{18}H_{33}O_2)_3$, is the principal constituent of olive oil, and by expressing the oil, after solidifying, in a freezing machine, as much as 70 per cent of pure olein was obtained, which, on saponification, yielded glycerine and an oleate of the alkali used.

Pure oleic acid can be obtained by decomposing the oleate with dilute sulphuric acid and agitating with an equal volume of ether.

Palmitic Acid, $C_{16}H_{32}O_2$, was isolated by Collett from the more solid portion of the oil after it had been saponified. Heintz and Krug also isolated arachic acid.

Cholesterin, $C_{26}H_{44}O$, may be separated from the oil by agitation with glacial acetic acid or alcohol, in which it is soluble (Benecke).

Tests for Olive Oil.—As olive oil is liable to considerable adulteration with other oils, *e.g.*, sesame, cotton seed, and drying oils, the following tests may be applied:—

(a) Add to 1 part of nitric acid, sp. gr. 1.42, 9 parts of the oil, and apply heat until the action is fairly set up, then remove the source of heat and stir until the action ceases. Pure olive oil sets to a pale straw-yellow mass on cooling, while cotton seed and other oils assume a deep orange-red colour, and do not set like olive oil (Conroy).

(b) Place 50 grains of the oil into a 150cc. cylinder, and add 10cc. of sulphuric acid, stir with a thermometer, and note the highest reading. Pure olive oil gives an increase of $42^{\circ}C$. (Maumené).

(c) Agitate the oil with an equal volume of strong hydrochloric acid and a little powdered sugar; the aqueous layer, on separating, should be colourless; if sesame oil be present it will acquire a pink colour.

(d) The fatty acids obtained from pure olive oil melt between 26.5° and $28.3^{\circ}C$., and solidify not lower than $22^{\circ}C$. (Bradford).

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(e) Agitated with a solution of sub-acetate of lead, pure olive oil saponifies instantly; if cotton seed oil be present it acquires a red colour, and saponifies slowly (Bradford).

(f) Agitated with bisulphite of calcium it forms a yellowish-white emulsion (Dragendorff).

ASCLEPIADACEÆ.

No. 133. Hemidesmi Radix. *Hemidesmus Root.*

Indian Sarsaparilla. Nannari.

The dried root of *Hemidesmus Indicus*.

Habitat.—Indigenous throughout India and Ceylon.

Characters.—In cylindrical, more or less twisted, longitudinally furrowed, thick, tortuous pieces, six inches or more in length; covered by a thin yellowish-brown corky layer, which is easily removed from the outer portion of the bark; it is transversely fissured, forming annulations. Odour fragrant and agreeable; taste sweetish and slightly acrid.

Composition.—No reliable analysis of *hemidesmus* root has been made, but according to Scott it yields a minute proportion of a volatile stearoptene. The cortex contains a little tannin, and the root contains starch.

Official Preparation.—*Syrupus Hemidesmi.*

LOGANIACEÆ.

No. 134. Nux Vomica. *Nux Vomica.*

Poison-Nut. Quakers' Buttons.

The seeds of *Strychnos Nux Vomica*.

Habitat.—This medium sized tree is found growing throughout India, Burmah, Southern China, and the East Indian Islands.

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Characters.—The Fruit is a globular berry of a bright yellow colour, about the size of a Tangerine orange; primarily it is bilocular, but the dissepiments ultimately retrograde into a fleshy mass, indistinguishable from the central pulp of the fruit; the pericarp forms a thin, firm shell, enclosing a white gelatinous and intensely bitter pulp, in which the seeds are found imbedded; the pulp is poisonous, containing strychnine and brucine.

The Seeds are in the form of a rounded disc, about an inch in diameter and a quarter of an inch thick; they are sometimes flat, but generally have one side convex and the reverse concave, with thickened or occasionally acute edges; on the concave surface, and at its centre, is found the hilum, which is connected by the raphe to the chalaza; the raphe is frequently somewhat elevated, forming a ridge, which terminates in the rounded chalaza situated on the edge. The surface varies from a dull grey to a very silky yellowish-grey colour, due to numerous fine satiny hairs, which are closely adpressed, and radiate towards the circumference: in texture the seeds are hard and horny, the perisperm being of a yellowish-grey colour. When the seeds are macerated in water for some time, they become soft, and can then be easily split, upon which is seen the embryo, which is composed of two minute cordate cotyledons, which are seven-veined, the two outer veins being well marked, and terminate in a rounded radicle. The seeds are inodorous but have a persistent disagreeable taste; as they are with difficulty reduced to powder, they ought to be steamed for some time, then rapidly dried, and immediately comminuted in an iron mortar or drug mill.

Composition.—The fruit and seeds contain the alkaloids, strychnine and brucine, igasuric or strychnic acid, and a glucoside, loganin; the seeds, in addition, contain fat, protein compounds, to which the hard horny character of the perisperm is due, a little tannin, and sugar.

Strychnine, $C_{21}H_{22}N_2O_2$. Various methods are employed in preparing this alkaloid; Henry's process consists in exhausting the drug with alcohol acidulated with sulphuric acid. Duflos' method, which is employed on a commercial

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scale, consists in extracting the drug by boiling with very dilute sulphuric acid, concentrating the decoction, and adding milk of lime, which precipitates colouring matter and alkaloids with calcium sulphate. The precipitate is washed with ice-cold water to remove colour, and then with very weak alcohol, which removes brucine, and finally treated with boiling strong alcohol, which dissolves the strychnine. This latter is purified by precipitation and recrystallisation from spirit; or the precipitate is boiled with 10 per cent. sulphuric acid, which removes the alkaloids as sulphates, the solution is decolorised, and the alkaloids precipitated by means of an alkali, the precipitate is collected, washed, and redissolved in boiling spirit, the strychnine separated by fractional crystallisation, and the brucine allowed to crystallise from the mother liquor. The alkaloids can also be separated by re-solution in 4 per cent. sulphuric acid, and precipitating the strychnine as ferrocyanide by means of potassium ferrocyanide, decomposing the salt with ammonia, and crystallising from alcohol. (Dunstan and Short.)

Strychnine forms tetragonal prisms, which are very sparingly soluble in water, ether, and absolute alcohol, more readily soluble in hot aqueous alcohol, chloroform, benzene, and amylic alcohol. It dissolves in dilute acids, neutralising them and forming crystalline salts, which are more soluble in water, and on the addition of ammonium thiocyanate a crystalline precipitate of the strychnine thiocyanate is thrown down. When heated in sealed tubes with hydrochloric acid for some time, it is converted into two salts, the dihydrostrychnine and trihydrostrychnine, which differ in their solubilities; also when treated with bromine it forms bromo derivatives. Strychnine and its salts are extremely poisonous, and from its intensely bitter taste no other alkaloid is likely to be mistaken for it.

Reactions of Strychnine.

1. To neutral solution of the alkaloid add solution of potassium chromate } Orange-yellow needles of strychnine chromate crystallise out.

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2. Dissolve the alkaloid in strong sulphuric acid, then add a minute speck of potassium chromate, or use a crystal of strychnine chromate instead. (Guy) } A deep rich blue colour, passing to purple, then orange red.
3. Dissolve the alkaloid in nitro-sulphuric acid, then add manganese peroxide. (Erdmann) } A purple violet colour is produced.
4. Add a drop of the solution to a few drops of strong sulphuric acid in a small platinum cup, then connect this with the positive pole of a Smee's battery, and touch the acid with the negative pole; a violet colour flashes out, which remains on removing the pole (Letheby).

Similar colours to No. 2 are produced by substituting cerium oxide (Sonnenschein), ferricyanide of potassium (Davy), or iodic acid (Lefort).

Amongst the salts of strychnine more commonly used are the phosphate, sulphate, nitrate, hydrochlorate, and acetate.

Test for Purity.—Concentrated sulphuric acid dissolves the alkaloid without colour, and on incineration no ash should be left (absence of inorganic matter). Strong nitric acid should dissolve it without giving a red colour (absence of brucine), or if a colour is produced, it should only be very faint.

Brucine, $C_{23}H_{26}N_2O_4$. This alkaloid is obtained from the mother liquor after the crystallisation of strychnine, by neutralising it with sulphuric acid, evaporating to dryness, redissolving in water, and precipitating by ammonia, then crystallising from hot alcohol. It crystallises in plates or prisms, and is less poisonous than strychnine. According to Dr. Falck, one part of strychnine is equal to 117.4 parts of brucine; he also states that strychnine kills three times more quickly than brucine. Brucine is soluble in water, more so in alcohol, and very readily in chloroform; like strychnine its solution is lævorotatory. It dissolves in dilute acids, forming crystallisable salts, which,

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with the exception of the acetate, are easily soluble in water. When dissolved in strong nitric acid, and kept cold by means of ice-cold water, a brisk evolution of nitric oxide takes place, and on the solution standing kakotelin separates in fine, hard, orange red crystals, leaving oxalic acid in solution (Strecker). If brucine is dissolved in strong alcohol, and a little methyl iodide added, on shaking the mixture minute rosettes of methyl-brucine iodide separate.

Reactions of Brucine.

- | | |
|---|---|
| 1. On the addition of strong nitric acid to a crystal | } Deep red colour, changing to orange, then yellow. |
| 2. Add a crystal to a weak acid solution of mercurous nitrate (Flückiger) | |
| 3. Boiled with perchloric acid for a few minutes | } Fine carmine colour. |
| 4. Agitate with chlorine water | |
| | } Fine Madeira colour. |
| | |
| | } Evanescent pink colour is produced. |
| | |

The reactions of brucine are not interfered with when strychnine is present, and it is important in cases of poisoning to ascertain if both alkaloids are present.

Igasurine. Considerable doubt has been expressed as to the presence of this alkaloid; it was first isolated by Desnoix, after which it was examined by Schützenberger, who stated it to be a mixture of alkaloids.

Strychnic or *Igasuric Acid* may be obtained from the extract by precipitation with lead acetate, collecting the lead strychnate, and decomposing it with sulphuretted hydrogen, filtering and evaporating, when it crystallises out. It occurs in small, hard, warty crystals, and is probably identical with malic acid (Pelletier and Caventou).

Loganin, $C_{25}H_{34}O_{14}$. This glucoside was isolated recently, first from the pulp of the fruit, which contains about 5 per cent., and then from the seeds, by Dunstan and Short. They state that on hydrolysis it yields loganethin and glucose. It is only found in small quantities in the seeds.

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The tannin present in the seeds gives a dark green coloration with neutral ferric chloride.

Assay of Nux Vomica.—Take 10 grams of finely powdered seeds, and pack in an extraction apparatus, and exhaust with chloroform containing one-quarter of its volume of alcohol. Exhaustion is known to be complete by quickly removing the receiver and fixing a fresh one, collecting the chloroform mixture, and agitating this with twice its volume of weak hydrochloric acid, removing the aqueous layer, and adding a solution of potassio-bismuthic iodide, when no precipitation will occur if all the alkaloid is removed. One hour's slow percolation is generally sufficient, after which the chloroform mixture is repeatedly agitated with weak hydrochloric acid, the acid solutions are mixed, ammonia is added in faint excess, and then 10 cc. of chloroform, the whole is agitated, and the chloroform removed, poured on a tared dish, carefully evaporated on a water bath to dryness, cooled and weighed. The resulting weight of alkaloids multiplied by 10 will give the percentage. The highest recorded yield of alkaloids was 5.34 per cent. (Dunstan and Short).

Commerce.—Regarding the value of the different shipments of Nux Vomica, those that are imported from Bombay and Ceylon are the best; next come those from Cochin-China and Singapore, and lastly Madras.

Official Preparations. — Extractum Nucis Vomicae; Strychnina; Tinctura Nucis Vomicae.

No. 135. Semen Ignatii. *St. Ignatius' Bean.*

Synonym:—*Faba Sancti Ignatii.*

The seed of *Strychnos Ignatii* (*Strychnos Philippinensis Ignatia amara*)

Habitat.—A climbing plant, indigenous to the Philippine Islands, and naturalised in Cochin-China.

Characters.—The seeds, of which from 18 to 24 are found imbedded in the pulp of the berry, are about one inch in

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length, oblong or ovoid, and by mutual pressure irregularly angular; the hilum is conspicuous at one end in a small depression. Internally the seeds are very hard and horny, with a minute cavity in the centre, into which projects the embryo, which consists of a rather long bent radical and pointed cotyledons. Externally the seeds are of a dull brownish-grey colour, and when fresh are covered with silky hairs. Although different in outline, they are identical in botanical structure with the seeds of *Nux Vomica*. The seeds are inodorous, and break under pressure with a granular and irregular fracture. They have a persistent disagreeable taste, and are extremely poisonous.

Composition.—*St. Ignatius* seeds contain the same constituents as *Nux Vomica*, but in different proportions, generally a larger percentage of strychnine is found, and as much as 1.5 per cent. has been recorded (Geiseler).

Commerce.—When met with in English markets they are quickly bought up for the preparation of the alkaloids.

Other Species of Strychnos.

Strychnos potatorum, indigenous to India. The seeds are sub-globular, greyish-brown in colour, and with an insipid taste, devoid of bitterness. They are used in India for clearing muddy water, and are known as clearing nuts. They do not contain brucine or strychnine.

Strychnos Tieute, found in Java; the seeds are smaller than those of *Nux Vomica*, and of a paler colour. An extract is made from them which is used as an arrow poison; they contain strychnine and brucine.

Strychnos colubrina or *Snakewood* is used in India as an antidote for snake bites. The entire plant contains brucine and strychnine.

Strychnos toxifera, *Strychnos Schomburghii*, and other species, mixed together and boiled, yield an extract known as *Curare* or *Wourali*, the arrow-poison of British Guiana.

Strychnos pseudo-Quina, a native of Brazil, is the source of *Quina do campo* bark, which is used in that country as a febrifuge; its fruit is edible.

*Loganiaceæ.***No. 136. Gelsemium.** *Yellow Jasmine or Carolina Jessamine.*

The dried rhizome and rootlets of *Gelsemium nitidum* (*Gelsemium sempervirens*).

Habitat.—Indigenous to the Southern States of North America.

Characters.—The subterranean woody stem as met with in commerce is nearly cylindrical, and occurs in pieces of from one to six inches in length, and about half an inch in diameter; the stem breaks with tough splintery fracture, the bark then showing the scattered silky fibres of its bast tissue; the wood is porous, pale yellow, and traversed with numerous light-coloured medullary rays, with a dark central pith; the true root is similar, but has no central pith. Odour slightly narcotic and aromatic; taste disagreeably bitter.

Composition.—Gelsemium contains a characteristic alkaloid gelsemine, and a peculiar acid gelseminic, besides a small quantity of volatile oil, resin, starch, and allied matter to pectin.

Gelsemine, $C_{12}H_{14}NO_2$ (Gerrard), is obtained by exhausting the drug with alcohol, concentrating the tincture, and adding dilute sulphuric acid, which precipitates the resin, filtering, and agitating the filtrate with ether or chloroform, to remove the gelsemic acid, then precipitating the alkaloid by addition of a solution of sodium carbonate, and removing the gelsemine with chloroform (Wormley). The pure alkaloid is crystalline, slightly soluble in water, and forms crystalline salts with acids, their solution having an intensely bitter taste.

Reactions of Gelsemine.

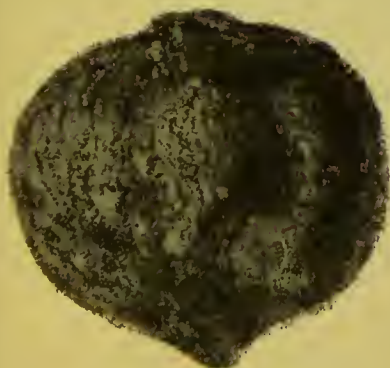
- | | | |
|--|-------|-----------------------------------|
| 1. Strong sulphuric acid and a speck of potassium bichromate | } | Fine damask red colour. |
| 2. Fröhde's Reagent | ... { | Reddish-brown, changing to green. |
| 3. Strong nitric acid | ... { | Brown, changing to deep green. |
| 4. Strong sulphuric acid and cerium oxide | } | Cherry red. |



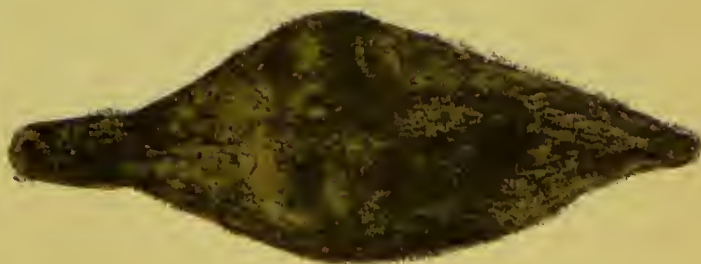
N° 137.



N° 139.



N° 141.



N° 141 (Tampico)



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Gelsemine is distinguished from strychnine by the characteristic reaction the former gives with strong nitric acid.

Gelseminic or Gelsemic Acid. This powerful fluorescent body was stated by Robbins and Sonnenschein to be identical with æsculin, but more recently Wormley proved that it was a distinct body. It is obtained on evaporation of the ethereal solution obtained prior to the precipitation of gelsemine. It crystallises from ether, and dissolves in strong sulphuric acid with a yellow colour; it is precipitated from solution on addition of metallic salts. On boiling with dilute sulphuric acid it yields glucose and another body; its principal reaction is its strong fluorescence, 1 part in 15,000,000 being easily recognised, particularly on addition of a little potassium hydrate.

The drug yields about .4 per cent. of gelseminic acid and .2 per cent. of gelsemine.

Official Preparations.—Extractum Gelsemii Alcoholicum; Tinctura Gelsemii.

GENTIANACEÆ.**No. 137. Gentianæ Radix. *Gentian Root.***

The dried root of *Gentiana lutea*.

Habitat.—It is indigenous to the mountainous districts of Central and Southern Europe.

Characters.—The root is more or less cylindrical, fleshy, and simple, in pieces or longitudinal slices, from a few inches to a foot or more in length, and nearly one inch thick. The upper portions of the roots are deeply annulated, the lower end being wrinkled; externally the root varies from a dark greyish to a yellowish-brown; internally it is of a yellow or reddish-yellow colour; spongy, and has a peculiar heavy, characteristic odour. The central portion is separated by the very dark cambial zone. The root is flexible and tough; it tastes at first sweet, then intensely bitter. Its cold infusion is not coloured blue by the addition of a solution of iodine.

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Composition.—Gentian root contains a peculiar bitter principle gentiopierin, with gentisic acid, and about 15 per cent. of an uncrystallisable but fermentable sugar named gentianose. The root also contains a notable amount of pectin, but no starch, and small quantities of a crystalline body which is highly fluorescent.

Gentiopierin, $C_{20}H_{30}O_{12}$. This, the bitter principle of gentian, is readily soluble in alcohol and water, and is best prepared by dissolving an alcoholic extract in water, adding some freshly ignited animal charcoal, which absorbs it, then filtering, treating the charcoal with boiling alcohol, which removes it, concentrating the spirit and triturating the residue with plumbic oxide, to remove colour, filtering and passing a current of sulphuretted hydrogen through the solution to remove lead, decanting the clear solution, and slowly evaporating, when the gentiopierin crystallises out. It is readily decomposed on boiling with dilute acids, yielding gentiogenin ($C_{14}H_{16}O_5$) and glucose, the former being insoluble in cold water.

Gentisic Acid, $C_{14}H_{10}O_5$ (gentisin or gentianic, or gentianotannic acid), is prepared from the filtrate after absorption of the gentiopierin, by first agitating the filtrate with ether, evaporating to dryness, and redissolving in alcohol, from which gentisic acid crystallises. It is easily soluble in alkalies, and on fusion with caustic potash it yields phloroglucin and gentisinic acid, $C_7H_6O_4$. This acid is the cause of the dark colour produced by gentian with solutions of iron.

Gentianose is the peculiar sugar found in the root. It does not reduce Fehling's solution. Advantage is taken of this sugar in fermenting decoctions of the drug, thereby obtaining a potable spirit.

Substitutes.—Frequently the roots of other species of gentian are collected; they possess similar properties. It is difficult to distinguish them, except when the plant is in flower. The following are the principal three that are used:—*G. punctata*, *G. Pannonica*, *G. purpurea*.

Official Preparations.—*Extractum Gentianæ*; *Infusum Gentianæ* Co.; *Tinctura Gentianæ*.

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No. 138. Chirata. Chiretta.

The dried entire plant *Ophelia Chirata* (*Gentiana Chirata*). Collected when the fruit begins to form.

Habitat.—An annual plant, indigenous to the hills of Northern India.

Characters.—The root is about 2 or 3 inches long, slightly tortuous, generally unbranched, of a light reddish-brown colour externally, brittle, the centre being hard and woody; the stem cylindrical in its middle and lower half, but four-sided towards the apex, nearly 3 feet long, branching dichotomously, smooth, brown or purplish in colour. The leaves are opposite, sessile, ovate, five-nerved, in some samples absent. The flowers are numerous and small, arranged in racemose cymes. The fruit is a capsule, surrounded by the persistent calyx, and contains numerous seeds. The whole plant is inodorous, and has a marked bitter taste.

It is generally imported in bundles, tied up with strips of bamboo.

Composition.—Chiretta contains two bitter principles, ophelic acid and chiratin, which were isolated by Höhn.

Ophelic Acid, $C_{13}H_{20}O_{10}$, is a brown amorphous mass, extremely hygroscopic, with a slightly acidulous, then persistent bitter taste. It readily reduces Fehling's solution, and is soluble in ether, water, and alcohol.

Chiratin, $C_{26}H_{48}O_{15}$, is a pale yellow powder, only sparingly soluble in water, more so in alcohol and ether. Its solution does not reduce Fehling's solution, but is easily decomposed; by boiling with dilute acids it yields chirato-genin, $C_{13}H_{24}O_3$, and ophelic acid. It is also precipitated from its solution by tannin.

Substitutes.—As there are other species of *Ophelia* found in India, and are also collected, they may occasionally be met with; the principal varieties are *Ophelia densifolia*, *O. multiflora*, and *O. angustifolia*.

More recently the stems and leaves of Munjeet have been found in bales of the drug. It is readily distinguished

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by its twisting stem, absence of outer bark and pith, and its red colour; the leaves have long petioles, and are arranged in whorls. Its botanical source is *Rubia cordifolia*, *Rubiaceæ*.

Official Preparations. — Infusum Chiratæ; Tinctura Chiratæ.

CONVOLVULACEÆ.**No. 139. Scammoniæ Radix. Scammony Root.**

The dried root of *Convolvulus Scammonia*.

Habitat.—The Scammony plant is found in Asia Minor, Syria, and Greece.

Characters.—The root varies in size and length, is unbranched, cylindrical, tapering, and more or less twisted, and at the top presents the remains of numerous slender aerial stems; it is furrowed longitudinally, and covered with a greyish-brown bark; pale brown or white internally, and when broken numerous fragments of pale yellow resin are found on the fractured surface. It is hard and woody, with a faint nauseous odour, and taste slightly resembling jalap.

Composition.—The root contains about 5 per cent. of scammony resin, and is said to contain most resin prior to the flowering of the plant; it also contains a small quantity of tannin and about 12 per cent. of sugar. The resin can be readily extracted by percolation with spirit and recovering the spirit by distillation, when it is left as a residue.

Official Preparation.—Scammoniæ Resina.

No. 140. Scammonium. Scammony.

A gum-resinous exudation obtained by incision from the living root of *Convolvulus Scammonia*, hardened in the air.

Collection.—The brushwood amongst which the plant grows is first cleared, and the soil removed so as to expose

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a portion of the root; this is then cut in a slanting direction and a mussel shell stuck into it below the lower edge. The shells are generally collected in the evening, and the surface of the root scraped to remove any resin; the contents of the shells being usually emptied into a pot, stirred until homogeneous, and then exposed to the air to dry. Frequently the mass is softened by exposing it to the sun, it is then kneaded into a plastic mass, and during this process considerable sophistication is carried on, the principal addition being flour or earthy matter, after which it is spread out in masses and dried. The bulk of the Scammony of commerce is collected near Smyrna and Aleppo.

Characters.—As met with in commerce, Scammony occurs in angular or circular cakes, varying in size, ashy-grey or brownish-black externally, and occasionally covered with a greyish-white powder. It is very brittle and breaks with a splintery fracture, the broken surface being resinous, shiny, and porous, and of a dark greyish-black colour; the powder when triturated with water forms a smooth greenish emulsion. Odour peculiar, sour and cheesy; taste acrid, producing a tingling of the fauces. A cold decoction gives generally a blue colour with iodine, which is slight; when treated with ether it ought to lose four-fifths of its weight.

Composition.—Scammony consists principally of resin, which varies between 50 and 95 per cent.; good scammony ought to contain at least 75 per cent.; the remainder being gum, with a little mineral matter.

The Resin consists almost entirely of scammonin with a little colouring matter. Scammonin is the anhydride of scammoninic acid, and is decomposed, on boiling with dilute acids, into scammoniolic acid and glucose. Scammony resin when pure is of a brownish colour, becoming a pale buff on treatment with charcoal, it is glossy and very brittle; it has a sweetish odour but is almost tasteless, and when triturated with water it does not form an emulsion. It is entirely soluble in ether, turpentine, alcohol, and solution of potassium or ammonium hydrate, and the solution, on the addition of an acid, remains clear. Its alcoholic

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solution does not acquire a green colour on addition of chlorine water, nor does it colour the fresh cut surface of a potato (absence of guaiacum resin).

Assay of Scammonium. Take 5 grams of previously dried and finely powdered scammony, mix it with an equal bulk of powdered pumice, and percolate the mixture with ether until exhausted, then distil off the ether and weigh the residue, which multiplied by 20 gives the percentage of resin.

Therapeutics.—A drastic purgative.

Official Preparations.—Mistura Scammonii, and Resina Scammoniae.

No. 141. Jalapa. Jalap.

The dried tubercules of *Ipomea purga* (*Exogonium Purga*).

Habitat.—The plant is indigenous to the Mexican Andes, and is cultivated in Jamaica, and on the Nilgherry Mountains in India.

Collection.—The tubercules are collected during the whole year, but more particularly in spring, and as drying by exposure to the sun's heat is almost impossible on account of the wet climate, they are strung on pieces of cord, and suspended from the top of the Indian's hut, and are more or less smoke-dried. The smaller pieces are dried entire, but the larger tubercules are either split longitudinally or sliced to facilitate the drying. The bulk of the jalap is imported in a bad condition, being mouldy and otherwise unfit for use; this is owing to imperfect drying.

Characters.—The tubercules are irregularly oblong, somewhat ovoid, napiform or depressed globose, sometimes pyriform or nearly cylindrical, varying in size from that of a walnut to a man's hand. Externally they are dark brown with a smoky appearance, irregularly furrowed and wrinkled, marked with short paler transverse lines and numerous broad corky warts; internally they have a brown or dirty

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yellowish-brown colour, and are marked with irregular concentric rings. The bark is easily removed after macerating in water; on the inner surface numerous resin cells are visible. Jalap has a peculiar smoky sweetish odour, increased on rubbing; the taste is nauseous and acrid. Good jalap should be ponderous, hard, and compact, and should break with a resinous fracture.

Composition.—Jalap contains a characteristic resin, with gum, sugar, and starchy matter.

The amount of resin varies in different samples, as much as 22 per cent. having been obtained; but the average ranges between 12 and 18 per cent., and ought not to be under 10 per cent. It is composed of two bodies, one being soluble in ether, and the other insoluble; the latter is the chief constituent, amounting to about 90 per cent. of the resin. This insoluble portion is the convolvulin of Mayer and the rhodeoretin of Kayser. When purified by means of animal charcoal it is colourless, tasteless, and inodorous, and readily soluble in alcohol and fixed alkalies, and is not precipitated on addition of mineral acids, being converted into convolvulic acid, $C_{62}H_{106}O_{35}$. Convolvulin or jalapurgin, $C_{62}H_{100}O_{32}$, when heated with dilute acids, yields convolvulinol and glucose; the convolvulinol is decomposed by alkalies into convolvulinolic acid. When convolvulin, or its derivatives, is treated with nitric acid 1.30, it yields oxalic acid and ipomic acid, $C_{10}H_{18}O_4$. The portion soluble in ether, which rarely exceeds 10 per cent., is designated jalapin, the same name being applied to the resins of Orizaba jalap. Jalapin is homologous with convolvulin, and is readily soluble in chloroform, phenol, benzol, and ether. When submitted to the same reactions as convolvulin, it yields jalapic acid, jalapinol, and jalapinolic acid. Tampicin is the resin of Tampico Jalap, and is identical with jalapin (Spirgatis). The jalapin of commerce is usually soluble in ether.

Substitutes.—Occasionally other varieties of jalap are met with, more particularly the tubercules of Tampico Jalap obtained from *Ipomea simulans*. In appearance it closely resembles true jalap, but occurs in more elongated tuberous pieces, deeply wrinkled, and destitute of the small scars

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found on true jalap. It yields from 12 to 15 per cent. of resin almost entirely soluble in ether (Umney).

The Male or Woody Jalap consists of the tubercles of *Ipomea Orizabensis*. It is paler in colour, compact, broad, and of a fibrous texture, and deeply wrinkled longitudinally. It yields nearly 12 per cent. of resin, which is soluble in ether.

Assay of Jalap.—Take 10 grams of finely powdered jalap and percolate it with warm alcohol until exhausted, concentrate the tincture and pour the residue into water, collect the precipitated resin, wash, dry, and weigh. The weight multiplied by 10 will give the percentage. Macerate the residue with ether for twelve hours, decant the ether, then dry the residue on a water bath; the loss ought not to exceed 10 per cent.

Therapeutics.—A brisk purgative.

Official Preparations.—Extractum Jalapæ; Pulvis Jalapæ Co.; Pulvis Scammonii Co.; Resina Jalapæ; and Tinctura Jalapæ.

SOLANACEÆ.**No. 142. Stipites Dulcamaræ. *Dulcamara*.**

Synonym :—*Bittersweet, Woody Nightshade.*

(*Not official.*)

The young stems and branches of *Solanum Dulcamara*.

Habitat.—Indigenous throughout Europe. Found in Asia Minor and North Africa. Naturalised in North America.

Characters.—The stems and branches of the older portions are woody, and only the shoots of the younger parts ought to be collected when about two years old. They are two or three feet in length, cylindrical, furrowed longitudinally, and marked with small warts. The corky layer is of a pale greenish-yellow colour, and easily exfoliates, exposing a dark-green bark. In the older pieces the wood is porous

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and marked with fine medullary rays, the stalks are mostly hollow, or contain a white pith. Odour disagreeable when fresh; taste at first bitter, then sweetish.

Composition.—Bittersweet contains a glucoside dulcamarin, dulcarin, or picroglycion, and two doubtful alkaloids, solanine and dulcamarine.

Dulcamarin, $C_{22}H_{34}O_{10}$. This body was isolated by Geissler, who prepared it by agitating a strong infusion with animal charcoal, washing, and exhausting with alcohol, evaporating off the alcohol, and dissolving the residue in water, adding ammonia, and filtering from the precipitate, adding to the filtrate a solution of lead acetate, collecting the precipitate, suspending it in alcohol, and decomposing with sulphuretted hydrogen, decanting the clear solution, and carefully evaporating. It is a yellow amorphous powder, decomposed by dilute acids into glucose and dulcamaretin. It is soluble in alcohol, water, and acetic ether, and is precipitated from its solution by tannin. Strong sulphuric acid dissolves it with a red colour, changing to rose.

Solanine is a peculiar body of glucosidal character, and yields sugar and solanidine (Gmelin).

Dulcamarine.—The amorphous alkaloids of Wittstein were found to be a mixture of resin and dulcamarin.

Adulteration.—Occasionally the cut stems and branches of the honeysuckle and hop have been found in dulcamara, but on comparison with the above characters are easily recognised.

Therapeutics.—Alterative.

No. 143. *Capsici Fructus. Capsicum Fruit.*

Synonyms:—*Guinea, Cayenne, African, Red, and Pod Pepper.*

The dried ripe fruit of *Capsicum fastigiatum*.

Habitat.—Supposed to be indigenous to South and Central America, and to have been introduced into India and

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Africa by the Portuguese. It now grows wild in Southern India, and is largely cultivated in tropical Africa.

Characters.—The fruit, which is a two-celled berry, is about three-quarters of an inch in length, supported by a flattened calyx. It is somewhat shrivelled, conical-oblong, obtuse, and composed of a smooth, bright scarlet, brittle, thin pericarp, which is translucent, enclosing two cells, containing, attached to the thick central placenta, numerous reniform, yellowish seeds, slightly thickened at the edges. The embryo is semicircular, and enclosed in succulent perisperm. Odour peculiar and pungent, and the taste of both pericarp and seeds is extremely pungent and fiery. This is the only variety allowed by the British Pharmacopœia.

Composition.—Capsicum fruit contains a volatile alkaloid, a crystalline body capsaicin, a red colouring principle, a fat, and minute traces of a volatile oil.

The *Alkaloid* was first isolated by Felletar, by exhausting the fruits with dilute acid and distilling with caustic potash. It is strongly alkaline, and possesses the peculiar odour of conine, but differs from it in the form of its crystalline hydrochlorate (Dragendorff). It is not precipitated from its solution by tannin, nor is it coloured by Fröhde's reagent.

Capsaicin ($C_9H_{14}O_2$) was first obtained pure by Thresh. It is colourless, and melts at 138° F., emitting extremely irritating vapours. It is readily soluble in alcohol, ether, benzine, and amylic alcohol, and is decomposed by nitric acid, forming an oily liquid.

The colouring matter is intimately mixed with the fat, which is principally palmitin. It is readily soluble in chloroform, fixed oils, and bisulphide of carbon, but only sparingly in alcohol.

The *Volatile Oil* is only found in minute traces, and has a parsley-like odour. It consists chiefly of a stearoptene (Flückiger and Hanbury).

Allied Varieties of Capsicum.—Capsicum annuum yields the large fruits, known as Pod Pepper, which are largely used in this country. They are much larger, being from



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1 to 4 inches in length, and more or less conical ; on drying they acquire a brownish-red colour. The plant is a native of South America. *Capsicum longum*, and *C. grossum*, are only varieties of *C. annuum*.

Capsicum frutescens is a native of the East Indies. The fruit is about the size of the *C. fastigiatum*, but not so pungent.

Nepaul pepper has a violet odour and flavour. Natal pepper has a bright red colour, and affords the finest red Cayenne pepper. Paprika is the fruit of *Capsicum tetragonum* ; it is given to canaries in the form of powder to increase the yellow colour of their feathers. It has very little pungency, and forms a deep red oily powder.

Adulteration.—Cayenne pepper is principally adulterated with red mineral powders, chiefly brick dust and red lead. They are easily detected by the increase in the percentage of ash, which should not exceed 6 per cent. Starches are sometimes met with. They are best recognised by the microscope.

Therapeutics.—Powerful stimulant and rubefacient.

Official Preparation.—Tinctura Capsici.

No. 144. Belladonnæ Folia. *Belladonna Leaves.*

Deadly Nightshade, Dwale.

The fresh leaves of *Atropa Belladonna* with the branches to which they are attached ; also the leaves, separated from the branches and carefully dried, gathered when the fruit has begun to form, from plants growing wild, or cultivated in Britain.

Habitat.—The plant is a native of Central and Southern Europe ; it is cultivated throughout Europe, and in some districts in North America.

Characters.—The forked herbaceous stem bears on the upper branches numerous bright green leaves in unequal pairs surrounding the solitary dull purple flower. They are broadly ovate with an entire margin, smooth, and from

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three to six inches long. On drying they lose a little over 80 per cent. of their weight, and become thin and friable, assuming a brown colour on the upper surface, and greyish-green on the under. Odour, which when fresh is heavy and disagreeable, is lost on drying; taste nauseous and bitter.

Composition.—The leaves contain the alkaloid atropine, but in smaller amount than the root, according to Lefort about .4 to .5 per cent. They also contain asparagin, which was found in a crystalline mass in the extract (Biltz). The extract prepared from the leaves contains crystals of nitrate and chloride of potassium (Attfield). On incineration the leaves yield between 14 and 15 per cent. of ash.

Admixtures.—The leaves of *Solanum nigrum* have been found amongst those of belladonna; they are smaller, and the margin usually repand-dentate. In samples of carelessly gathered belladonna leaves, the leaves of *hyoscyamus* and *digitalis* are sometimes found, but they are readily distinguished from the belladonna by their hairy appearance and outline.

Official Preparations.—*Extractum Belladonnæ*; *Succus Belladonnæ*; *Tinctura Belladonnæ*.

No. 145. Belladonnæ Radix. Belladonna Root.

The root of *Atropa Belladonna* from plants growing wild or cultivated in Britain, or imported in a dried state from Germany.

Characters.—Belladonna Root is generally collected from plants two or three years old, and is a foot or more in length, and from one to two inches thick. When fresh it is cylindrical, tapering, and fleshy, but when dry it is deeply wrinkled. The upper end is marked with the hollow bases of the stems; externally, it is rough and of a dirty grey colour; internally, whitish. It breaks readily with a short fracture; a transverse section shows a thin cortical portion of a yellowish or pale brown colour, separated by a dark line from the central portion of a light brown colour, marked with numerous dark-coloured dots; the wood

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bundles are arranged in radiating lines. When fresh the root has a nauseous odour; taste bitterish and acrid.

Composition.—The most important constituent of the whole plant is the alkaloid atropine, of which the roots contain nearly .5 per cent.; they also contain hyoscyamine, belladonnine, a colouring principle atrosin, malic acid, and a minute quantity of a soft fatty principle, probably butyracin.

Atropine, $C_{17}H_{23}NO_3$. This alkaloid is prepared from the root, for which more than one process is employed. That by Procter gives very satisfactory results; it consists in exhausting the drug with spirit, and treating the tincture with lime and sulphuric acid, filtering and removing most of the spirit by distillation, then pouring the residue into water, when resin and fat are precipitated, and are removed by filtration; the filtrate is rendered alkaline with caustic potash, and then agitated with chloroform, which removes the alkaloid. It is obtained in pale yellow crystals on evaporating the chloroform, and is purified by recrystallising from alcohol. It is preferable to precipitate the alkaloid with bicarbonate of potassium; the precipitation should always be done in the cold, because atropine is readily decomposed with alkalies even when kept in contact with them in the cold. Atropine, when pure, is in fine crystals, which melt at $236^{\circ}F.$; it is freely soluble in alcohol, chloroform, turpentine, and in dilute acids, neutralising them, and forming crystalline salts. Recently, Ladenburg has studied the constitution of this alkaloid. Kraut and Lossen first showed that atropine, when treated with barium hydrate, yields tropine and tropic acid, $C_{17}H_{23}NO_3 + H_2O = C_9H_{10}O_3 + C_8H_{15}NO$, and continuing those researches Ladenburg found that atropine, hyoscyamine, and hyoscyne are isomeric alkaloids, all corresponding to the formula $C_8H_{15}NO$, but that they differ in physiological action to a certain extent. A recent examination has demonstrated the fact that hyoscyamine is the natural alkaloid in belladonna, but in the process of extraction, saponification takes place, when it is converted into atropine.

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Atropine, when treated with nitric acid, yields apoatropine (Pesci), which crystallises in fine prisms. Apoatropine, $C_{17}H_{21}NO_2$, is freely soluble in alcohol and chloroform slightly in water, and its solution has no action on the eye; with nascent hydrogen it yields hydro-apoatropine $C_{17}H_{23}NO_2$.

Reactions of Atropine.

1. To an alcoholic solution of atropine add a few drops of a similar solution of mercuric chloride, and gently warm. } Brick red precipitate of mercuric oxide appears.
(Gerrard.)
2. Add to a crystal a drop of fuming nitric acid, dry on a water bath, then drop a little alcoholic potash on the mass. } Violet colour passing to red.
(Vitali.)

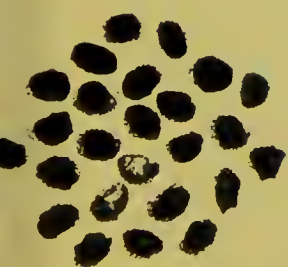
Atropine forms a number of crystalline salts with acids, amongst which the sulphate, hydrochlorate, salicylate, and nitrate, are the more common ones. Occasionally the alkaloid is adulterated with its salts, this system of adulteration being a common one with expensive alkaloids.

Tropine, $C_8H_{15}NO$, is a strongly alkaline body crystallising in white deliquescent needles. It combines with organic acids, forming secondary alkaloids called tropidines; in this way Ladenburg has produced a number of compounds, of which homatropine is one of the principal; it is prepared from tropine and mandelic acid by boiling the two with some strong hydrochloric acid in a sealed tube, and then precipitating with sodium carbonate.

Homatropine acts like the other mydriatic alkaloids in dilating the pupil.

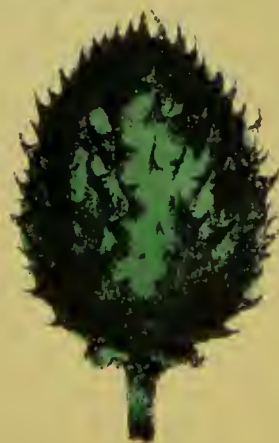
Tropic Acid, $C_9H_{10}O_3$, occurs in fine crystals, and by continued action of hydrochloric acid, is converted into atropic and then isatropic acids, $C_9H_8O_2$.

Belladonnine was first separated from commercial atropine by Hubschmann; it is uncrystallisable, and only sparingly



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soluble in water. It is separated from atropine by adding to its solution a small quantity of carbonate of potassium. It is said by Schmidt and others to be a mixture of atropine and oxyatropine.

Atrosin is a red colouring principle found in the root, which also contains a fluorescent body (Hubschmann).

Assay of Belladonna Root. Take a weighed quantity of the root, and exhaust it with spirit; evaporate the tincture to dryness in a water bath, dissolve the extract in chloroform, and agitate this twice with an equal volume of dilute sulphuric acid, which removes the alkaloids, mix the acid solutions, and add carbonate of potassium until alkaline, then a little chloroform, agitate, after which remove the chloroformic solution of atropine, carefully evaporate on a water bath, dry, cool, and weigh.

Therapeutics.—Anodyne and cardiac stimulant.

Official Preparations.—Atropina; Linimentum Belladonnæ; Extractum Belladonnæ Alcoholicum.

No. 146. Stramonii Semina. *Stramonium Seeds.*

The dried ripe seeds of *Datura Stramonium*.

Habitat.—Found growing throughout Europe, Asia, and America.

Characters.—The seed-vessel is a spiny ovoid capsule, opening at the apex into four valves, and having two spurious dissepiments, which do not reach the top of the capsule. When the pericarp separates the seeds are found attached to the central columella. When ripe the seeds are brownish-black in colour, reniform, flattened, the testa being finely pitted, and coarsely reticulated; the hilum is situated on the sinus. The testa is hard, and encloses an oily perisperm, in which the round embryo is embedded. The seeds are inodorous, but when bruised emit a heavy disagreeable odour; the taste is oily and bitter.

Composition.—Stramonium seeds contain the alkaloid daturine, a peculiar principle stramonin, about 25 per cent.

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of a fixed fatty oil, and small quantities of mucilaginous and resinous matter. The seeds on incineration yield nearly 3 per cent. of ash.

Daturine exists in the seeds and other parts of the plant as malate. When first isolated it was regarded as being composed of two alkaloids. According to more recent investigations by Schmidt and Ladenburg, it consists of atropine, with varying proportions of hyoscyamine; that examined by Schmidt was nearly pure atropine.

Stramonin was prepared by Trommsdorff as a white tasteless powder, readily soluble in ether, slightly in alcohol, and insoluble in water.

The seeds, when macerated entire in alcohol, form a solution with a bright-green fluorescence.

Therapeutics.—The same as Belladonna.

Official Preparations.—Extractum Stramonii; Tinctura Stramonii.

No. 147. Herba Stramonii. *Stramonium.*

Synonym:—*Thornapple.*

(*Not official.*)

The dried young shoots and leaves of *Datura Stramonium*.

Collection.—The stramonium produces an upright herbaceous stem, which throws off numerous branches bearing the leaves and white flowers; for medicinal purposes the leaves and young shoots are chiefly employed. The leaves are situated on long petioles, and are unequal, varying from 3 to 8 inches in length, ovate, unequal at the base, one side being somewhat decurrent on the petiole; the apex is acuminate, the margin irregularly sinuate-dentate. The older leaves are glabrous, the young ones downy. When recently collected the leaves have a disagreeable nauseous odour, and are somewhat fleshy, but after drying they become thin and brittle, lose the fœtid odour, and are of a greyish-green colour; taste saline and bitter.



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Composition.—The leaves, as well as the whole plant, contain daturine, but in minute quantities, and when incinerated yield 17 per cent. of ash, of which nearly one half is soluble in water.

Allied Plants:—

Datura Tatula closely resembles the official plant, but is distinguished by its purple-coloured stem and violet flowers. It has been considered a variety of *D. Stramonium*, but Naudin, who has studied them both for some time, regards them as distinct.

Datura alba is common throughout India. The capsules are more globular, with shorter spines containing numerous yellowish-brown seeds. Their activity is probably due to daturine, but the tincture is not fluorescent.

No. 148. *Hyoscyami Folia.* *Henbane Leaves.*

The fresh leaves and flowers, with the branches to which they are attached, of *Hyoscyamus niger*; also the leaves separated from the branches and flowering tops carefully dried. Collected from biennial plants growing wild or cultivated in Britain, when about two-thirds of the flowers are expanded.

Habitat.—Indigenous throughout Europe, Northern India, and Egypt, naturalised in North America and Brazil. In Britain it is found growing in waste places, but is cultivated in several counties, Lincoln, Herts, Surrey, Kent, &c., for medicinal purposes.

Characters.—Henbane being a biennial plant, it is essential that only the biennial leaves be used in preparations. The leaves taken from the lower part of the stem are stalked, whilst those on the upper branches are sessile and amplexicaul; they vary in length, the larger leaves being nearly a foot long; they are exstipulate, triangular-ovate, acute, sinuate-dentate, pale green, and glandular, hairy, particularly on the under surface and on the veins; when fresh they are clammy, with a strong heavy odour; taste somewhat bitter and acrid.

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Composition.—Henbane leaves contain the alkaloids hyoscyamine and hyoscine, together with a peculiar odorous principle, malic acid, gum, and sugar. The seeds, in addition, contain a glucoside hyoscypicrin and an acid resin.

Hyoscyamine, $C_{17}H_{23}NO_3$. This alkaloid is obtained by exhausting the seeds with acidulated alcohol, the bulk of the spirit being removed by distillation, and the residue neutralised with hydrate of potassium; the alkaloid is then precipitated by tannin, the precipitate triturated with lead oxide and macerated in chloroform to remove the hyoscyamine, which crystallises from solution in silky needles. The leaves yield about .04 per cent., and the seeds .18 per cent. Hyoscyamine is isomeric with atropine, from which it differs in its melting point; it is decomposed by barium hydrate into tropine and tropic acid, formerly described as hyoscine and hyoscinic acid. As met with commercially it nearly always contains minute quantities of an amorphous alkaloid, named hyoscine by Ladenburg, but first named sikemaine. Hyoscyamine on being heated to the temperature of its melting point, passes readily into atropine; a similar change is easily brought about by treating with a trace of alkali.

Hyoscine, when treated with barium hydrate, yields tropic acid and pseudo-tropine; it is uncrystallisable, but forms crystalline salts with acids.

The odorous principle was examined by Gerrard, who obtained about 2.5 grams of it. It forms a pale yellow semi-crystalline mass, which is acid in reaction. On further examination he found it to contain butyric acid, and regarded it as a butyrin.

Hyoscypicrin, $C_{27}H_{52}O_{14}$, is a bitter glucoside obtained by Hohne; it is readily soluble in water and alcohol, and when boiled with dilute sulphuric acid yields glucose and a white resin.

An extract of henbane distilled with caustic potash gives, amongst other volatile compounds, ammonia and methyamine.

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Other Species of Hyoscyamus:—

Hyoscyamus agrestis (*H. annua*). An annual variety, rarely exceeding a foot in height; it bears fewer flowers of a pale yellow colour, and the leaves are nearly smooth.

Hyoscyamus albus, a slender plant with more obtuse leaves. The leaves are collected in Southern Europe in place of *H. niger*, var. *biennis*; they are less active.

Adulteration.—Considerable quantities of *Stramonium* leaves have recently been imported as exotic henbane; an examination of the above characters will readily distinguish them.

Therapeutics.—The same as belladonna, but the plant is milder in its action.

Official Preparations.—*Extractum Hyoscyami*; *Succus Hyoscyami*; *Tinctura Hyoscyami*.

No. 149. Hyoscyami Semen. Henbane Seed.

(Not official.)

The ripe seed of *Hyoscyamus niger* from wild or cultivated plants.

Habitat.—They should be obtained from plants growing in this country.

Characters.—The capsule (pyxis) is surrounded by the persistent bell-shaped calyx, and is about half-an-inch in length, dehiscing near the top in a transverse manner; it is bilocular, and contains numerous seeds. The seeds are small, roundish or reniform, flattened, the testa is roughly pitted, and of a greyish-brown colour, enclosing a white oily perisperm, in which is embedded the curved embryo; the hilum is situated on the concave side. They are inodorous, and have an acrid, oily, bitterish taste.

Composition.—They contain the alkaloids hyoscyamine and hyoscyne in greater quantity than any other part of the plant, and are principally used for the preparation of hyoscyamine. There is also a considerable amount of a

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bland, fatty oil to the extent of 25 per cent., which is partly soluble in alcohol.

Henbane seeds were official in the older Pharmacopœias.

No. 150. Tabaci Folia. Tobacco Leaves.

The commercial dried leaves of *Nicotiana Tabacum*.

Habitat.—Indigenous to tropical America. It is cultivated in all sub-tropical countries.

Characters.—The leaves of the tobacco plant vary considerably in size: those situated on the lower part of the stem are about two feet long and six inches wide, the upper leaves being much smaller; ovate, ovate-lanceolate or oval-oblong, pointed and acute at the apex, with an entire margin, and a thick and prominent midrib, and in the fresh condition they are covered with numerous viscid hairs. Colour when fresh, bright green; odour narcotic; after drying they become brown, brittle, thin, and more or less mottled; odour heavy; taste nauseous, bitter, and acrid.

When cultivated, the leaves and flowering tops are generally collected in September, just before the flowers open; they are then dried and stripped from the stalks, and packed in boxes or hogsheads.

Composition.—Tobacco leaves contain an alkaloid nicotine, a peculiar body nicotianin, sugar, fat, tannin, and a large quantity of salts.

Nicotine ($C_{10}H_{14}N_2$), when pure, is an oily, colourless fluid. For its preparation numerous methods have been devised by Schloessing, Wittstein, Barral, and others. Preparation:—The leaves are exhausted with acidulated water, and the infusion concentrated, then rendered alkaline with caustic potash, and agitated with ether, which removes the nicotine, the ethereal layer is decanted, and the ether allowed to evaporate. The residue is neutralised with oxalic acid, the nicotine oxalate removed by alcohol, and distilled with caustic potash, and the alkaloid purified by redistillation in a current of hydrogen or carbonic oxide.

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It boils at 240° C., but at the same time it is decomposed, and always leaves a resinous residue ; the percentage varies considerably, from 1.5 to 11 per cent. It neutralises acids, forming crystalline salts.

Reactions of Nicotine.—Chlorine gas passed through it colours it blood-red. Cyanogen gas colours it brown, but does not form a crystalline compound like chlorine. When an ethereal solution of iodine is added to one of nicotine, in a short time it forms fine, long, needle-shaped crystals. It does not coagulate albumen like conine. Strong sulphuric acid colours it wine-red. Nicotine is highly poisonous, and the toxic effect of tobacco smoke is due to its presence, as well as other picolinic alkaloids, resulting from its decomposition, such as pyridine, collidine, and picoline.

Nicotianin or *Tobacco Camphor* is obtained by distilling tobacco leaves with water, when it is found floating on the surface of the distillate in minute crystals. Barral states that it contains nitrogen ; but this is perhaps due to traces of nicotine it may be contaminated with, as when pure it is odourless and tasteless.

The Sugar was examined by Attfield, who found it in quantity amounting to nearly 10 per cent., and according to his experience it has little if any action on polarized light.

The Fat was obtained by percolating the leaves with ether, partly removing the ether by evaporation, and pouring the residue into alcohol, when it is precipitated. It is purified by crystallising from boiling alcohol. It melts at 63° C., and was found by Kissling to consist of mellissyl-mellissate.

The leaves also contain a peculiar tannin, which is identical with caffeotannic acid (Savory). On incineration the leaves yield a large quantity of ash, ranging from 15 to 30 per cent.

Assay of Tobacco.—Take a weighed quantity of the finely powdered leaves, and mix it thoroughly with half its weight of slaked lime, pack in a tube, and connect it with

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a vessel containing boiling water, the other end dipping into dilute sulphuric acid; then allow the steam under slight pressure to pass through the tube, when nicotine and ammonia are carried over and retained by the acid. The solution of the sulphates is then evaporated to dryness, and exhausted with strong alcohol, which removes nicotine sulphate. This is recovered by evaporation, and the sulphate distilled from caustic lime, the distillate is passed into a measured volume of semi-normal sulphuric acid, and the excess of acid is titrated with normal caustic soda. 1cc. of centi-normal acid = .00322 gram of nicotine.

SCROPHULARIACEÆ.**No. 151. Digitalis Folia. Foxglove Leaves.**

The leaves of *Digitalis purpurea*. Collected from wild British plants of the second year's growth, when about two-thirds of the flowers are expanded, and carefully dried.

Habitat.—Indigenous throughout Southern and Central Europe.

Characters.—Foxglove is a biennial or perennial plant, the leaves differ in size according to their situation; the radical leaves are the largest, being often one foot or more in length, and ovate or ovate-lanceolate in outline; the stem leaves are smaller, and the petioles shorter, the petiole is winged and sometimes purplish in colour. In all the leaves the margin is irregularly and doubly crenate or subserrate, the upper surface is wrinkled, and dull green, slightly downy, the under surface of a pale greyish colour, densely pubescent and reticulated, with prominent veins; the midrib is broad at the base, tapering to a fine point, and of a purple colour. Taste bitter and unpleasant; odour faint, tea-like, but agreeable.

Composition.—*Digitalis* leaves contain a characteristic class of glucosides known as the digitalins, the more important being digitalin, digitonin, digitalein; they also contain digitin and digitacrin, a peculiar fatty body, a sugar inosite, with gum and chlorophyll.

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Digitalin, $C_{54}H_{80}O_{27}$. This name has been applied to several bodies, and that obtained by the Pharmacopœia of 1867 consisted of more than one substance; there are usually two varieties in the market, the soluble German digitalin and insoluble or French digitalin, but as the active principle of digitalis is freely soluble in water, this latter must be mixed with some insoluble substance, such as resin. Nativelle's digitalin is obtained as follows: the leaves are first macerated in water, and then strained, after which they are exhausted with spirit. The tincture is evaporated to a small volume, and then poured into water, and after a week decanted. The precipitate is drained, pressed, and then boiled in alcohol, and during the boiling a little lead acetate is added. After cooling, the tincture is filtered, and to the filtrate is added charcoal, after which the spirit is recovered by distillation; the charcoal is then exhausted with chloroform, from which, on standing, the digitalin crystallises; it is purified by recrystallisation from hot alcohol in fine needles. Digitalin is inodorous, but possesses a very bitter taste, is soluble in alcohol and chloroform, but insoluble in water or ether. Dilute sulphuric acid decomposes it on boiling, first into glucose and digitaletin, $C_{44}H_{30}O_{18}$, then into digitaleretin, $C_{44}H_{38}O_{18}$, and ultimately into dehydrated digitaleretin. Strong sulphuric acid dissolves it, forming after a short time a fine green colour, which, on addition of bromine, passes into a violet red. Hydrochloric acid forms an emerald green solution, which, on addition of water, throws down a resinous body.

Digitonin, $C_{31}H_{52}O_{17}$, is found in commercial digitalin, from which it differs in its solubility in water. It is a white amorphous substance, and is closely allied to saponin; its solution in water froths, and it is precipitated by barium hydrate. Digitonin in solution is coloured a beautiful red on addition of sulphuric or hydrochloric acid; by this reaction it differs from saponin; when boiled in dilute acid it yields glucose, digitoresin, and digitonein; it is not affected by bromine.

Digitalin, $C_{21}H_{46}O_{11}$, like digitonin, is readily soluble in water and absolute alcohol. It gives the same reaction as

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digitalin, with strong sulphuric acid and bromine, but yields, on hydrolysis, glucose and digitaliresin. When pure it is in colourless grains.

Digitoxin, $C_{21}H_{32}O_7$, always accompanies digitalin in foxglove; it dissolves readily in chloroform and alcohol, and is insoluble in water, sparingly in ether. It occurs in platy crystals or needles, gives an emerald green solution with hydrochloric acid, and yields, on treatment with dilute acids, toxiresin, which is soluble in ether. Toxiresin is intensely poisonous, and crystallises from ether in colourless scales.

Digitalin, digitonin, digitalein, and digitoxin agree in their powerful physiological action; digitaletin, digitaleretin, and paradigitaleritin are less active.

Digitin is a resinous substance which crystallises from alcohol; it is physiologically inactive.

Digitoleic acid is a fatty body isolated by Kosmann.

Inosite, $C_6H_{12}O_6 + 2 H_2O$, is a peculiar sugar, and is found in many plants; when evaporated to dryness with nitric acid it gives a beautiful rose colour.

Adulteration.—Foxglove leaves are sometimes mixed with the leaves of one or more species of *Verbascum*; these are easily distinguished by their thick covering of stellate hairs; the leaves of *Inula Conyza* are recognised by the smaller veins being less prominent, and by the lateral veins at the base not being decurrent into the petiole, as is the case in *digitalis*.

Therapeutics.—A cardiac sedative and tonic.

Official Preparations.—Infusum Digitalis; Tinctura Digitalis.

LABIATÆ.**No. 152. *Menthæ piperitæ* Herba. *Peppermint.***

The dried tops and leaves of *Mentha piperita*.

Habitat.—Found wild throughout Central and Southern Europe and North America. Largely cultivated in England, United States, Germany, and France.

Characters.—The stem is erect, firm, and angular, slightly pubescent and frequently tinged with purple. The leaves are

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petiolate, from two to three inches in length, varying in shape from lanceolate to ovate, slightly rounded at the base, the apex narrow and acute; the surface is dark green above, paler beneath and glandular. The inflorescence consists of about fourteen whorls, the lower ones being somewhat apart, each whorl containing about twenty flowers; in the upper whorls the flowers are crowded together. The flowers are purplish, with the corolla protruding, the fruit consists of four rugose achenia. The entire plant has an aromatic odour, and strong pungent and cooling taste.

This plant is distinguished from *Mentha viridis* by its stalked leaves, and obtuse less tapering inflorescence. Bentham considers it a variety of *M. hirsuta*.

Composition.—The principal constituent is the essential oil, but besides this it contains a little tannin.

The Essential Oil is obtained by distilling the fresh flowering tops with water, or preferably, by passing a current of steam through the crushed drug. The oil is colourless, or pale yellow or greenish, becoming viscid and brown with age; its specific gravity ranges between .84 and .94. Taste pungent and aromatic, followed by a sensation of cold, particularly on inspiring air. It is soluble in three parts of alcohol, which, on a further addition of alcohol, becomes cloudy, and deposits a light sediment. The oil consists of a mixture of menthol, $C_{10}H_{19}OH$, and menthon, $C_{10}H_{18}O$, the latter can be converted into menthol by dissolving it in ether and then adding the requisite proportion of sodium (Beckmann.) Its most important constituent is menthol or mint camphor, $C_{10}H_{19}OH$, which it deposits on exposure to cold.

Colour Reactions of the Oil.

Add 1 drop of nitric acid to 70 of oil, then warm	} First brown, then violet, and finally greenish-blue.
Impure chloral .....		Rose red colour.
Dropped on melted sali- cyclic acid	} Blue green.
Warmed with Picric acid...	
Chloroformic solution of bromine	} Violet colour, fading to pink

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Adulterations.—The oil is sometimes adulterated with alcohol, castor oil, turpentine, and the American oil may accidentally contain oil of erigeron.

Tests.—Iodine, when added to the oil, should have little or no action (absence of turpentine). The oil should be easily soluble in three parts of spirit (absence of castor oil and turpentine). Dropped on paper, it should leave a translucent stain, which should disappear in a few minutes (absence of castor oil). When agitated with twice its volume of warm glycerine it should not diminish in volume on separating (absence of alcohol). If oil of erigeron be present, the oil will have a rank hemlock-like odour, and is acted on violently with iodine.

Therapeutics.—Aromatic.

Official Preparations of the oil.—Aqua Menthæ Piperitæ ; Essentia Menthæ Piperitæ ; Spiritus Menthæ Piperitæ.

No. 153. Menthol. *Menthol or Mint Camphor.*

A stearoptene obtained by cooling the oil distilled from the fresh herb of *Mentha arvensis*, vars. *piperascens* and *glabrata*, and of *Mentha piperita*.

Habitat.—*Mentha arvensis* is found growing wild in Japan and China, and the oil is largely distilled for the preparation of Menthol.

Characters.—Menthol occurs in acicular crystals, or in crystalline masses, sometimes moist from adhering oil; those obtained from *M. piperita* are snow white and acicular, and are nearly always moist, while those from the oil of *M. arvensis* are firm and more or less transparent. The two differ slightly in their physical properties, but are chemically the same (Trimble). The melting point should lie between 108° and 110° F.; taste warm, camphoraceous, and aromatic; odour resembling the oil. When rubbed on the skin menthol first produces extreme cold, then a tingling numbness.

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Composition.—Menthol is a monhydric alcohol, $C_{10}H_{19}OH$, contaminated more or less with the neutral hydrocarbons of the oil. When treated with phosphoric chloride it yields menthyl chloride, and with phosphoric anhydride it gives menthene, $C_{10}H_{18}$, boiling at $163^{\circ}C$. Menthol oxidised with permanganate of potassium yields an acid, $C_{10}H_{18}O_3$, and oxalic and carbonic acids (Arth). When heated it entirely evaporates, leaving no residue. That obtained from *M. piperita* is known as Pipmenthol.

Adulterations.—Menthol has been subjected to considerable adulteration, chiefly with phenol, thymol, salicylic acid, spermaceti, and magnesium sulphate.

Tests.—A little wrapped in paper and placed on a water-bath should leave no residue or oily stain. Dissolve a little in glacial acetic acid and gradually add six drops of strong sulphuric acid, then a drop of nitric acid; thymol, if present, will give a green changing to fine blue; and a violet colour is produced if phenol is present (Eykman). When agitated with water the solution should not give a violet colour with neutral ferric chloride (absence of salicylic acid). Spermaceti or wax, if present, will increase the melting point.

Therapeutics.—Antiseptic and anæsthetic.

No. 154. *Menthæ viridis* Herba. Spearmint.

The dried leaves and tops of *Mentha viridis*.

Habitat.—Indigenous to England and the greater part of Europe, and cultivated largely in the United States.

Characters.—The stem is two or three feet in height, erect, angular, and firm, and branching below; green, but sometimes tinted with purple, and somewhat pubescent at the nodes. The leaves are sessile; a few of the lowest have short petioles; they are from two to three inches in length, lanceolate, smooth, acute, and serrate; midrib prominent and purple on the under surface, which is also densely glandular. The inflorescence is in paniced narrow spikes

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consisting of whorls, or more strictly speaking verticillasters, containing about fifteen flowers in each. The flowers are purplish, tubular, or bell-shaped; the corolla is exserted, and twice the length of the calyx. The fruit consists of four smooth achenia. Spearmint has an aromatic odour and taste, resembling that of peppermint, but much less pungent.

Composition.—The plant contains a volatile oil and a little tannin.

The Essential Oil is obtained by steam distillation, and the plant yields about .5 per cent. It is colourless, pale yellow or greenish-yellow, becoming reddish-brown by age; when fresh it dissolves in all proportions of alcohol without becoming opalescent. It is composed of an oxygenated hydrocarbon, $C_{10}H_{14}O$, isomeric with carvol (Gladstone), but differing from it in being levogyrate, and a neutral hydrocarbon, $C_{10}H_{16}$. An addition of about 4 per cent. of alcohol tends to preserve the odour and colour of this and other volatile oils.

Production.—Oil of Spearmint is seldom distilled in England; it is principally prepared in the United States. The German is prepared from *Mentha aquatica*, var. *crispa*, and is inferior to the true oil.

Therapeutics.—Aromatic.

Official Preparation of the Oil.—Aqua Menthæ Viridis.

No. 155. *Pulegii Herba.* Pennyroyal.

(Not official.)

The dried tops and leaves of *Mentha Pulegium*.

Habitat.—Indigenous to Europe; cultivated in South and North America.

Characters.—The stem is small and decumbent, about six inches in height. The leaves are about an inch long, petiolate, ovate; margin crenate; apex obtuse, densely glandular on both surfaces. The inflorescence is arranged in whorls,

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and extends some distance along the stem. Pennyroyal has a strong aromatic odour and taste.

Composition.—The entire plant contains the essential oil of a pale yellow colour, which, according to Kane, has the formula of $C_{10}H_{16}O$.

Production.—Oil of Pennyroyal is chiefly prepared in Germany and France. American Pennyroyal is *Hedeoma pulegioides*.

No. 156. Thymi vulgaris Herba. *Garden Thyme.*

(*Not official.*)

The dried leaves and branches of *Thymus vulgaris*.

Habitat.—Indigenous to Southern Europe, cultivated in England as a garden plant.

Characters.—The plant has a suffruticose stem bearing leaves about half an inch in length, linear or ovate oblong, with revolute margins, greyish-green in colour, pubescent on the under surface, and dotted with numerous oil glands. The flowers are reddish, and arise from the axils of the leaves. The whole plant is characterised by a white pubescence ; it is fragrant when rubbed, and has a pungent, aromatic taste.

Composition.—It contains an essential oil, which is the only constituent that has been examined.

The Essential Oil is distilled principally in France, by means of steam, from the entire plant ; when first prepared it is of a reddish-brown colour, which on re-distillation is colourless, or of a pale yellow. It has a warm aromatic taste, and is soluble in its own volume of alcohol. It is composed of thymol $C_{10}H_{14}O$, cymene $C_{10}H_{14}$, and thymene $C_{10}H_{16}$; the thymol is easily removed by agitating the oil with dilute soda solution, from which it is precipitated on addition of dilute mineral acids. Lemberger obtained 30 per cent. from the red oil, but on examining the white oil he only succeeded in obtaining 1 per cent.

The red oil is frequently substituted for or sold as the oil of organum, but is distinguished from the latter by iodine having no action on it.

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No. 157. *Lavandulæ Flores.* *Lavender Flowers.*

The dried flowers of *Lavandula vera*.

Habitat.—It is a native of Southern Europe, and is cultivated in most European countries, and in the United States.

Characters.—The flowers are borne on loose terminal spikes arranged in whorls, which arise from the axils of rhomboidal bracts. The calyx is tubular and contracted at the mouth, and is thirteen-nerved; it is densely covered with minute hairs and glands, and is of a bluish-grey colour. The corolla protudes from the mouth of the calyx, it is of a violet colour, tubular, pubescent and glandular on the outside, and bilabiate, the upper lip being two-lobed. Inside the throat of the corolla the stamens are situated. Lavender flowers have an agreeable and fragrant odour, which is more evident when rubbed; taste, aromatic and bitterish.

Composition.—The flowers contain resin, tannin, and an agreeable volatile oil, of which the fresh flowers yield about 1 per cent.

The Essential Oil is distilled from the flowers alone, or from the flowering tops, or from the entire plant by means of steam. That obtained from the flowers is the most fragrant and esteemed; the leaves and stalks yield a fragrant but ranker oil. The oil is of a pale yellow colour, or nearly colourless, and becomes viscid and acid on keeping; it is soluble in all proportions of strong alcohol, and on the addition of iodine it detonates slightly, with a rise of temperature. It is composed of a neutral hydrocarbon, $C_{10}H_{16}$, and a body closely related to camphor.

Adulteration.—Amongst the adulterations of lavender oil are camphene, oil of spike lavender, and alcohol. Camphene renders the oil less soluble in alcohol; oil of spike lavender produces a less fragrant odour, as it is distilled from the entire plant of *L. Spica*.

Production.—Oil of Lavender is principally distilled in the neighbourhood of Hitchin in Hertfordshire, and

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Mitcham in Surrey, where the yield is about 9 to 12 pounds weight per acre. It is also distilled at Avignon, in Piedmont.

Allied Plants.—*Lavandula Spica.* Spike lavender. This plant has spatulate leaves, and short dense spikes, and velvety flowers with linear bracts. It is grown largely in Southern France, where the oil is distilled.

Lavandula Stæchas. Arabian lavender. Is a small shrub growing near the Mediterranean, bearing purple flowers and bracts, with a strong aromatic odour. This plant has been claimed to be the source of true oil of spike.

No. 158. Rosmarinus. Rosemary.

The dried leaves of *Rosmarinus officinalis*.

Habitat.—Indigenous to Southern Europe and Asia Minor, cultivated in England.

Characters.—Rosemary leaves are about an inch long, entire, linear and opposite, margins revolute, obtuse at the ends, dark green on the upper surface, densely woolly and dotted with oil glands beneath. On drying, the leaves become more rigid, and of a paler colour. The plant has an agreeable aromatic odour, and a strong camphoraceous, pungent taste.

Composition.—The leaves contain a bitter principle, resin, tannin, and essential oil.

The Essential Oil is prepared from the entire plant, but a finer oil is obtained when the flowers alone are used; it is distilled by passing a current of steam through the crushed herb. The oil is almost colourless, with a warm, camphoraceous taste, and is soluble in its own weight of alcohol; it is quickly acted on by iodine, emitting reddish fumes, and is decomposed by chromic acid, yielding limetic acid, $C_{11}H_8O_6$; warmed with sulpho-molybdic acid it acquires a brown colour. It is composed of a neutral hydrocarbon, borneol, and laurinol.

Boraginaceæ.

Production.—Oil of Rosemary is chiefly prepared in the South of France, and in the island of Lesina, south of Dalmatia, whence it is exported via Trieste.

Therapeutics.—Rubefacient.

Official Preparation of the Oil.—Spiritus Rosmarini.

No. 159. Monarda. *American Horsemint.*

(*Not official.*)

The dried leaves and tops of *Monarda punctata*.

Habitat.—Indigenous to the United States.

Characters.—The leaves are about two inches long, acute at the apex, lanceolate, narrowed at the base into a petiole, dotted with numerous oil glands on the under surface. The flowers are arranged in whorls, each containing about 12 flowers arising from the axils of the leaves; calyx tubular and toothed; corolla protruding, upper limb arched, yellow and dotted with purple spots, and hispid. The entire plant has a strong aromatic odour, and warm bitter taste.

Composition.—The principal constituent is the volatile oil, for which the plant is distilled in considerable quantities.

The Essential Oil is prepared by steam distillation from the fresh plant. It is colourless when redistilled; the crude oil is of a reddish-brown tint. It is readily soluble in alcohol, and solidifies on application of cold. It is composed of a neutral hydrocarbon and thymol, and is one of the chief sources of the latter body, which is obtained by agitating the oil with caustic soda solution, or by submitting to extreme cold, and then pressing to remove the neutral hydrocarbon. The oil contains 25 per cent. of thymol, 50 per cent. of a hydrocarbon $C_{10}H_{16}$, the residue is composed of oxygenated hydrocarbons $C_{10}H_{18}O$ (Schroeter.)

BORAGINACEÆ.

No. 160. Alkannæ Radix. *Alkanet Root.*

(*Not official.*)

The dried root of *Alkanna tinctoria* (*Anchusa tinctoria*).

Habitat.—Southern Europe and Western Asia, cultivated throughout the South of Europe.



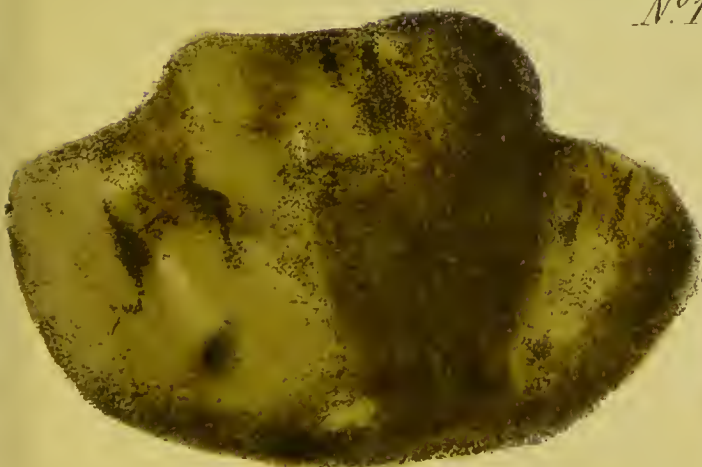
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(Russian)*



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(Russian)*



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(East Indian)*



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(Batavian)*

Polygonaceæ.

Characters.—Alkanet root is nearly a foot in length, divided, and crowned with the remains of the leaf stalks. The cortex is thin, and easily separated, and of a purplish colour; the central portion is spongy in texture, and of a reddish-brown colour; it is inodorous and tasteless.

Composition.—The root contains a characteristic colouring principle, anchusin or anchusic acid. It is obtained by first percolating the root with water, then treating the residue with alcohol; concentrating the tincture and diluting with water, acidulating with hydrochloric acid, agitating with ether, decanting the ethereal layer, and evaporating, when it is left as an amorphous, resinous mass. It is insoluble in water, soluble in alcohol and in dilute alkali solutions, forming a blue colour. It is principally used as a colouring agent.

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POLYGONACEÆ.

No. 161. *Rhei Radix.* *Rhubarb Root.*

The root, more or less deprived of its bark, sliced and dried, of *Rheum palmatum*, var. *Tanguticum*; *Rheum officinale*; and probably other species.

Habitat.—The rhubarb plants are natives of Northern and Western China, South-eastern Thibet, and throughout the highlands of Central Asia. Other varieties are cultivated in Austria, England, and France.

Characters.—Rhubarb root, as met with in commerce, consists of pieces of the rhizome cut transversely or longitudinally, and known as East Indian rounds and flats. They occur in somewhat cylindrical, conical, plano-convex, or irregularly formed pieces: they are frequently perforated with a small hole, in which is found the remains of the cord used for suspending the pieces when drying. The outer surface is frequently marked with small patches of the inner portion of the corky layer, and is carefully trimmed and smooth; sometimes slightly wrinkled, and usually covered with a bright yellowish-brown powder; on removal of the powder it is a rusty-brown colour, marked with dark rusty-brown

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striæ. When broken or cut transversely it presents a marbled appearance, in which the yellowish-white parenchyma is seen to be traversed with numerous reddish lines which are very irregular and radiate towards the circumference; near the cambial zone numerous star-like spots are seen which consist of the ends of the medullary rays. These spots are also found throughout the root. Rhubarb ought to be hard and compact, and break with an uneven and granular fracture; odour slightly aromatic and peculiar, and when chewed should taste gritty, and impart a yellow colour to the saliva.

Composition.—Rhubarb contains phæoretin, chrysophan, emodin, cathartic acid and rheotannic acid, besides variable quantities of calcium oxalate, fat, and pectinaceous matter.

Cathartic acid (rhein or rhubarbic acid). This substance varies in amount from 1·6 to 4·5 per cent., and is usually mixed with mucilaginous matter. It is prepared by exhausting the rhubarb with water, adding to the infusion three times its volume of alcohol; filtering from precipitated mucilage; evaporating the filtrate in a water bath; and exhausting the residue with absolute alcohol, which dissolves the resins and chrysophan, leaving the cathartic acid. It is a yellowish-brown substance soluble in water and in alkalies, and is decomposed on boiling with dilute acids.

Phæoretin, $C_{32}H_{32}O_4$. To the alcoholic solution obtained from the precipitated cathartic acid, add an equal volume of ether; this precipitates the phæoretin. Collect the precipitate and digest it in cold alcohol, which removes the phæoretin; decant and evaporate. It is a brown amorphous powder, insoluble in chloroform, ether, or water; soluble in alkalies forming a reddish-brown solution.

Chrysophan, $C_{27}H_{30}O_{14}$, is left in the crude state after removing the phæoretin; it is purified by digesting in cold benzol, in which it is readily soluble. When boiled with dilute acid it yields chrysophanic acid and glucose; it is an orange-coloured, bitter substance, readily soluble in water, sparingly in alcohol. Chrysophanic acid, $C_{15}H_{10}O_4$, which is formed from the glucoside chrysophan by the action of a ferment soluble in water but insoluble in alcohol, crystallises in brilliant needles, and is readily soluble in chloroform

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or benzol; it dissolves in alkalies forming a deep red solution, also in strong sulphuric acid with a bright red colour; it is one of the constituents found in the deposit from tincture of rhubarb.

Emodin, $C_{15}H_{10}O_5$. This is the residue left after removing the chrysophan with benzol; it is readily soluble in ether, and crystallises in needles from glacial acetic acid.

Rheotannic acid, $C_{52}H_{52}O_{28}$, is readily soluble in alcohol and water, and its aqueous solution gives a dark green colour with ferric chloride, and a greyish colour, turning blue, with ferrous salts; when boiled with dilute acids it yields glucose and rheumatic acid.

The root on incineration leaves about 14 per cent. of ash, but as much as 43 per cent. has been obtained. (Flückiger and Hanbury.)

Adulteration.—Powdered rhubarb is frequently mixed with the powder of English rhubarb, and sometimes with turmeric.

Test.—Place a little of the powder on white bibulous paper and moisten it with chloroform; after a few minutes remove the powder, turmeric or European rhubarb, if present, will have formed a deep yellow stain; good Chinese rhubarb only gives a light yellow. Moisten the stain with a solution of borax, and then a drop of strong hydrochloric acid; turmeric, if present, will be indicated by a change to a bright red; the stain from genuine rhubarb not being affected. (Howie.)

The Chinese or Asiatic rhubarbs, known in commerce as

Russian, or Turkey	} are yielded by {	Rheum palmatum,
Canton, or East		var. Tanguticum
Indian		and
Batavian, or Dutch trimmed		Rheum officinale.

Therapeutics.—Stomachic in small doses; purgative in large doses.

Official Preparations.—Extractum Rhei; Infusum Rhei; Pilula Rhei Composita; Pulvis Rhei Compositus; Syrupus Rhei; Tinctura Rhei; Vinum Rhei.

*Polygonaceæ.***No. 162. Rhei Radix Anglica.** *English Rhubarb Root.**(Not official.)*

The root, scraped, sliced and dried, of *Rheum Rhaponticum* and *Rheum officinale*.

Habitat.—Cultivated at Bodicote in Oxfordshire.

Characters.—The root of *R. officinale* is found in flat, concavo-convex or cylindrical pieces. The outer surface is marked with numerous deep longitudinal furrows and conspicuous veins. Usually a small round hole is bored through each piece to imitate Chinese Rhubarb; the fracture is granular, showing a compact structure traversed with numerous deep coloured veins, and marked with star-like spots; odour strong and aromatic; when chewed, the root has a gritty taste.

The root of *R. Rhaponticum* occurs in semi-cylindrical pieces, marked with numerous and deep longitudinal furrows, and is of a light reddish-yellow colour; the fractured surface is pale pink, soft and spongy, the medullary rays running nearly regular to the centre. Odour feeble, taste astringent, mucilaginous, somewhat bitter, and gritty. The cylindrical pieces are the upper segments of the lateral roots, and the “Stick” rhubarb consists of the lower segments.

Production.—The roots are seldom dug up until they are four years old; and the longer they are allowed to remain the better the quality. After digging they are lightly washed to remove earth, then peeled and sliced into pieces of suitable size, and dried first in a current of air and afterwards in a warm room. The shrunken appearance is partly remedied by a second paring, after which the drug is stored in a warm, dry place.

Composition.—In composition it is almost identical with the Asiatic rhubarb, but rarely yields more than 10 per cent. of ash, which chiefly consists of carbonates of potassium and calcium.



N^o 164.
Fruit.



N^o 165.



N^o 164.



N^o 171.



N^o 170.



N^o 167.



N^o 166.



*Myristicææ.**Sources of European Rhubarbs :—*

English	...	...	{ R. Rhaponticum. R. officinale.
French	...	...	{ R. Rhaponticum. R. compactum. R. undulatum.
Austrian	...	...	R. Rhaponticum. (Elborne.)

Commerce.—English rhubarb is principally exported, very little being used in this country.

No. 163. Bistorta. *Bistort, Snakeweed.*

(*Not official.*)

The dried rhizome and rootlets of *Polygonum Bistorta*.

Habitat.—Found growing throughout Asia, Europe, and North America.

Characters.—The rhizome is very irregular and usually bent backwards upon itself, transversely annulated from the remains of leaf scars, flat on one side and round on the other, marked with the scars of rootlets. Externally it is black or blackish-brown; internally, brownish-red. Texture firm and compact. Taste strongly astringent and slightly bitter.

Composition.—Snakeweed owes its astringent properties to tannic acid, of which Bowman found 21 per cent.

MYRISTICEÆ.**No. 164. Myristica.** *Nutmeg.*

The dried seed of *Myristica fragrans* (*Myristica officinalis*) divested of its hard coat or shell.

Habitat.—Indigenous to the Molucca Islands, cultivated in India, Sumatra, West Indies, and South America.

Collection.—The fruits are collected after they split, being detached from the branches by means of a pole or hook;

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the pericarp is then removed, after which the arillus is carefully detached from the nut-like seed. The nuts are then placed on frames and gently dried over a wood fire. This requires from six weeks to two months; during this time the nuts are frequently turned, at the end of this time the kernels rattle in the shell when shaken, they are then broken by means of a wooden mallet, assorted and packed. For the Chinese market they are exported in the hard shells. In the Dutch East Indies the kernels are usually packed in milk of lime, when they are known as limed nutmegs, the object being to prevent germination. The vitality is best destroyed by exposing the kernels to the sun's heat for about a week.

Characters.—The nutmeg, when in the shell, is about an inch long, with a glossy, brown, woody and brittle testa, bearing the configurations of the mace or arillus; the raphe is of a light brown colour. The kernels or nutmegs of commerce are oval or roundish, varying in length, but generally about an inch, marked at the broad end by a scar which is connected by numerous furrows to a depression at the upper end. Externally, it is of a light or greyish-brown colour, the furrows frequently containing a white powder (lime); internally, it is greyish-red, with darker reddish-brown markings, presenting a marbled appearance. This is caused by the enfolding endopleura, which penetrates into the perisperm in a very irregular manner. The embryo is situated at the broad end in a cavity of the perisperm; it is composed of a small radicle and two cup-shaped cotyledons. Odour agreeably fragrant and aromatic; taste oily, aromatic, and slightly acrid. Penang, Bencoolen, and Singapore nutmegs are unlimed.

Composition.—Nutmeg contains an agreeable volatile oil and a large quantity of fatty oil, with starch and proteinaceous matter.

The Essential Oil is obtained by distilling the nutmegs with water, or better, with steam, and as much as 8 per cent. has been obtained from picked seeds. It is a pale yellow limpid liquid, having the warm, aromatic, and camphoraceous odour and taste of the seed. Iodine acts on

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it with violence, as also nitric acid. When treated with hydrochloric acid it gives a violet colour. (Dragendorff). It consists of a neutral hydrocarbon myristicene, $C_{10}H_{16}$, and an oxygenated body myristicol, $C_{10}H_{14}O$, and sometimes contains myristic acid in solution.

The Fatty Oil is principally prepared in the East Indies by beating the nutmegs into a soft paste and then submitting them to pressure between hot plates, the yield being about 28 per cent. This oil is very incorrectly named *expressed oil of mace*, it is the *Oleum myristicæ expressum*. It is met with in blocks about a foot long, and wrapped in the leaves of a palm, it is unctuous to touch, of an orange-brown mottled appearance, and melts at 130° F., and is soluble in two parts of warm ether. It contains about 5 per cent. of volatile oil, which is removed by alcohol, which also dissolves out about one-fourth of its weight of resinous matter and fat, the white residue being nearly pure myristin. Myristin crystallises, from boiling alcohol, and on saponifying and decomposing the soap yields myristic acid; the latter exists to a certain extent free in the fat.

This fat is frequently adulterated with animal fats, it ought to dissolve in ten parts of alcohol, and, on filtering, the clear tincture should not be coloured red by ammonia (absence of turmeric), but brown.

Other Nutmegs.—There are other nutmegs met with occasionally, particularly the long nutmeg, derived from the *Myristica fatua* of which the mace is inodorous, and the kernel of a paler colour.

Therapeutics.—Aromatic stomachic.

Official Preparations.—*Oleum Myristicæ*; *Oleum Myristicæ Expressum*; *Pulvis Catechu Co.*; *Pulvis Cretæ Aromaticus*; *Spiritus Armoraciæ Co.*; *Tinctura Lavandulæ Co.*

No. 165. Macis. Mace.

(*Not official.*)

The dried arillus of the fruit of *Myristica fragrans*.

Habitat.—The Molucca Islands.

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Collection.—Mace is the arillus of the nutmeg, and is attached to the base of the woody testa of the hilum and the raphe of which it is an expansion; it is carefully removed from the shell, and dried by exposure to the sun, when the brilliant scarlet colour is changed to an orange yellow. Frequently, with the object of preserving it, it is sprinkled with salt.

Characters.—The entire arillus is about $1\frac{1}{2}$ inch in length, smooth and compressed, thicker at the base, and longitudinally slit into narrow branching bands, slightly translucent and fatty. It has an agreeable aromatic odour and taste resembling nutmegs.

Composition.—Mace contains a volatile oil and a considerable quantity of a coloured resin, with a little sugar and a peculiar starch.

The Essential Oil is obtained by distilling with steam. Mace yields about 8 per cent., it is composed of a neutral hydrocarbon, macene, isomeric with myristicene, but differing from it, according to Cloez, in not yielding a solid compound with hydrochloric acid gas, and an oxygenated hydrocarbon.

The Resin.—The residue, after removing the essential oil, yields to ether about 24 per cent. of an aromatic red coloured resin, which, when treated with alcohol, is separated into a red soluble and a yellow insoluble substance. It partly consists of semi-resinified essential oil.

Substitute.—Occasionally the arillus of the wild nutmeg has been offered for sale in its place. It is distinguished by its darker colour and absence of aromatic properties.

LAURACEÆ.**No. 166. Cinnamomi Cortex. *Cinnamon Bark.***

The dried inner bark of the shoots from the truncated stocks or stools of the cultivated cinnamon tree *Cinnamomum Zeylanicum*.

Habitat.—The cinnamon tree is a native of the island of Ceylon, but is also extensively cultivated.

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Collection.—The tree is pruned so as to form stools from which a number of shoots are raised; these are allowed to grow for about two years, or long enough for the corky layer to turn brown. The shoots, which have now attained a length of six or eight feet, are cut off, and the thin portions and leaves removed, these forming the cinnamon chips. The bark is now cut obliquely, or in a straight line, to a distance of twelve or eighteen inches; it is then removed by inserting the end of the peculiar knife which is used for the purpose. The strips are placed one within the other, made into bundles, and stored in a room for a day. The bundles are then withdrawn, undone, and each quill placed on a stick and carefully scraped to remove the outer layers. The small sticks are then placed within the larger ones, forming a rod of $3\frac{1}{2}$ feet long; these are at first kept in the shade and finally dried in the sun. When thoroughly dry they are made up into bundles of 20 or 30lbs. weight for exportation. Cinnamon is also produced in Java, Tellicherry, Brazil, and the West Indies, but of a quality inferior to the Ceylon cinnamon.

Characters.—Cinnamon bark occurs in closely rolled quills about 40 inches in length and about half an inch in diameter, composed of eight or ten layers of thin bark. The bark is very thin, brittle, splintery, and slightly pliable; it is of a dull, light yellowish-brown colour, externally smooth and marked with wavy lines, with a few scars left by branches or leaves. The inner surface is of a dark brown hue and slightly striate; odour agreeable and aromatic; taste aromatic, sweetish, and pungent.

Composition.—The bark contains a fragrant volatile oil, tannin, sugar, mannite, and starch. A decoction of cinnamon discharges the colour from a considerable amount of iodine.

The Essential Oil is almost entirely distilled in Ceylon from the chips and refuse bark by means of steam. It is a pale golden yellow liquid, becoming red or brownish-red with age, and on exposure to the air for some time it deposits crystals of cinnamic acid. The oil has a strong aromatic odour, and a hot, sweetish, and aromatic taste; it

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is readily soluble in alcohol, and is neutral to test-paper when fresh, becoming acid on keeping. Iodine dissolves in it without apparent action, afterwards forming a thick mass; nitro-prusside of copper changes it to red, then brown; nitric acid imparts a carmine colour; the oil ought not to congeal on addition of caustic potash. It contains cinnamic aldehyd, a little cinnamic acid, and, when old, some resin and several hydrocarbons. Cinnamic aldehyd can be removed by agitation with acid sodium sulphite, with which it forms a crystalline compound. When oxidised with permanganate of potassium it first evolves the odour of benzaldehyd, ultimately forming benzoic acid. Cinnamic acid can be removed by agitation with weak alkali, it forms colourless prisms, which dissolve readily in alcohol, and are inodorous.

Cinnamon bark also contains a substance which combines with iodine, preventing its action on the starch, until a very large quantity has been added. This substance has been shown by Flückiger and Hanbury not to be tannin; at present it is unknown.

Adulteration. — Cinnamon Bark. — The common and cheaper substitute, cassia or Chinese cinnamon, has been offered for Ceylon cinnamon, but its inferiority is readily recognised. The powdered cinnamon is more frequently mixed with powdered cassia, and is easily detected by the decoction readily giving a blue colour with one or two drops of iodine solution.

The Essential Oil is sometimes adulterated with cassia oil, with which it closely agrees in chemical composition, but differs in its physical properties. It is darker in colour, and raises the sp. gr. of the cinnamon oil, which is 1.0097 (Jackson). True cinnamon oil is lævogyrate, whereas cassia oil is dextrogyrate. The oil dissolved in alcohol should, on the addition of ferric chloride, not acquire a green or blue colour (absence of phenol or oil of cloves).

Other oils obtained from the cinnamon tree :

Oleum Cinnamomi Radicis, Oil of Cinnamon Root. — This oil is obtained by collecting the roots of old plants,

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then removing the bark and distilling the oil by passing a current of steam through it. It is a pale yellow liquid with an agreeable odour and camphoraceous taste, resembling more a mixture of cinnamon oil and camphor, it is lighter than water, and readily soluble in alcohol.

Oleum Cinnamomi Foliorum, Oil of Cinnamon Leaves.—This oil is obtained by chopping the leaves and mixing them with sea water, and then distilling. It differs from cinnamon oil in being of a brown colour, viscid, with an odour resembling a mixture of the oils of nutmeg and clove. It contains cinnamic acid (Khun) and eugenol, with neutral hydrocarbons. Both these oils are at times to be met with in the London market.

Therapeutics.—Aromatic stomachic.

Official Preparations.—*Acidum Sulphuricum Aromaticum*; *Aqua Cinnamomi*; *Decoctum Hæmatoxyli*; *Infusum Catechu*; *Oleum Cinnamomi*; *Pulvis Catechu Compositus*; *Pulvis Cinnamomi Compositus*; *Pulvis Cretæ Aromaticus*; *Pulvis Kino Compositus*; *Tinctura Cardamomi Composita*; *Tinctura Catechu*; *Tinctura Cinnamomi*; *Tinctura Lavandulæ Composita*; *Vinum Opii*.

No. 167. Cortex Cassiæ Chinensis. *Chinese Cinnamon Bark.*

Synonym :—*Cassia Bark.* *Cassia Lignea.*

(*Not official.*)

The dried inner bark of the shoots of *Cinnamomum Cassia* and other species of *Cinnamomum*.

Habitat.—Various species of cinnamon are found growing in the warm countries eastward of India, but the principal sources of cassia bark are the southern provinces of China, Tonquin, and Burmah.

Collection.—Amongst the other varieties of *Cinnamomum* that yield Cassia bark may be mentioned *C. iners*, *C. obtusifolium*, *C. Tamala*, and *C. pauciflorum*. In Southern China the trees are allowed to grow for 6 or 7 years before they are touched, the branches are then removed during the

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months of March, April, and May, by cutting close to the ground. The small twigs and leaves are removed, after which the bark is slit lengthwise and removed by inserting the edge of the knife. In this condition the bark is then laid out, and the outer layers removed by means of a small plane, after which it is allowed to dry, and then packed in bundles.

Characters.—Chinese cinnamon bark is met with in bundles, or in loose broken quills, the quills varying from a quarter to one inch in diameter; the outer surface is of a reddish-brown colour, finely wrinkled, marked at intervals with leaf scars and small patches of the suberous layer; it breaks with a somewhat short fracture; the odour resembles that of cinnamon, but is not so aromatic, being harsher.

Unscraped, or Saigon Cinnamon, is sometimes met with; the quills have a strong pungent flavour and sweetish taste.

Composition.—The bark contains an essential oil which is obtained by steam distillation; chemically it is closely related to true cinnamon oil, but differs somewhat in its physical properties. A decoction of this bark, when cold, gives a blue colour with a drop of solution of iodine.

Fructus Cassiæ Immaturæ, Cassia Buds.—These are the small unripe fruits of *Cinnamomum cassia*, and probably other species; they are principally exported from Canton. In appearance they closely resemble cloves, and consist of a thick perianth compressed over a small ovary. They have a cinnamon-like odour, a sweet aromatic taste, and contain an essential oil closely resembling that of the bark.

No. 168. Camphora. *Camphor.*

A stearoptene or concrete volatile oil obtained from the wood of *Cinnamomum Camphora* (*Camphora officinarum*), purified by sublimation.

Habitat.—It is found indigenous to Japan, Formosa, China, and Cochin China. The tree is cultivated in some districts in Italy.

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Collection.—The following method, as described by Oishi, is employed in Japan for its preparation:—The camphor wood is chopped up into small pieces and placed in a wooden tub provided with a perforated bottom; this is fixed on to an iron boiler containing water, and the top of the tub is connected, by means of bamboo pipes, with a flat wooden condenser. The condenser is surrounded with another wooden vessel containing cold water. Over this is placed another trough of the same size, in which water is kept to cool the top of the vessel. The boiler being filled with water, firing is applied, and as the steam rises it carries the vapours of the camphor and oil with it over into the condenser, where it solidifies and is mixed with oil and water. The process is repeated for about a week, after which the condenser is removed, and the camphor and oil taken out. The camphor is now strained from the oil and packed in barrels for exportation. In some districts in China it is obtained by boiling the chips with water and removing the camphor as it rises to the surface. By this crude method a considerable loss is sustained.

Refining.—As imported, camphor requires to be sublimed to free it from dirt and other impurities. The process of sublimation is carried out in glass vessels known as *bombaloes*, which are large depressed glass globes with a short neck. The camphor is reduced to powder and mixed with lime, sand, or charcoal, and packed at the bottom of these globes, and then placed on a sand-bath and at first rapidly heated to remove water, and then heated to about 400° F., and the temperature carefully regulated so that it condenses in solid masses. In America the camphor is distilled into a large chamber in which it condenses as a crystalline powder; this is afterwards submitted to powerful hydraulic pressure, and is compressed into solid cakes or blocks.

Characters.—Refined camphor is in solid colourless, crystalline, translucent, circular masses, traversed by numerous fissures when of any size; it is tough and not pulverisable unless previously moistened with alcohol, ether,

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or chloroform. It readily evaporates at ordinary temperatures, condensing in fine prisms or plates on the top of the vessel; it has a powerful penetrating odour, and an aromatic, pungent taste, followed by a sensation of cold. It floats on the surface of water, in which it is sparingly soluble, burns with a smoky flame, and is readily soluble in alcohol, chloroform, ether, and volatile oils.

Camphor, $C_{10}H_{16}O$, when distilled with chloride of zinc, yields several products, amongst which Armstrong and Miller found cymene $C_{10}H_{14}$, carvacrol $C_{10}H_{14}O$, and camphorone $C_9H_{14}O$; with phosphoric anhydride it yields cymene. When camphor is dissolved in chloroform, bromine added, and the solution heated, hydrobromic acid is evolved, and monobromide of camphor crystallises out of the solution. Nitric acid oxidises it into camphoric and camphoretic acids, ultimately yielding camphoronic acid.

Allied camphors and camphor oils:—

Borneo, Baros, or Sumatra Camphor, is obtained from the *Dryobalanops Camphora* (D. *aromatica*). Nat. Ord. *Dipterocarpeæ*. It is less volatile than laurinol or ordinary camphor, and harder; when placed in water it sinks. Odour somewhat different from ordinary camphor. In composition it has the formula $C_{10}H_{18}O$, and is known as borneol or camphyl alcohol; nitric acid converts it into ordinary camphor.

Ngai Camphor is obtained from *Blumea balsamifera*, Nat. Ord. *Compositæ*. It closely resembles borneol, and has the same composition.

Camphor oil is obtained on the separation of the camphor from the distillate. It is a mixture of terpenes, camphors, and oxygenated hydrocarbons, and varies in colour from a dark brown to a pale yellow. Its odour resembles a mixture of camphor and sassafras. Oishi obtained from some samples as much as 26 per cent. of ordinary camphor. The oil has been met with more frequently within the last two years.

Borneo Camphor Oil is an analogous product obtained in preparing that camphor. It is a pale yellowish liquid, with a somewhat terebinthinate odour.

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Adulteration.—As the Chinese export the whole of the camphor they prepare, and only use the Borneo variety, they have quite recently been sophisticating their camphor by mixing it with a transparent glue. The fraud is quite easily detected, and at a recent sale at Tamsui a considerable amount was rejected on this account.

Therapeutics.—Stimulant.

Official Preparations.

Aqua Camphoræ.	Linimentum Saponis.
Linimentum Aconiti.	„ Sinapis Co.
„ Belladonnæ.	„ Terebinthinæ.
„ Camphoræ.	„ Terebinthinæ
„ Camphoræ Co.	Aceticum.
„ Chloroformi.	Spiritus Camphoræ.
„ Hydrargyri.	Tinctura Camphoræ Co.
„ Opii.	Unguentum Hydrargyri Co.

No. 169. Sassafras Radix. *Sassafras Root.*

The dried root, reduced to chips or shavings, of *Sassafras officinalis*.

Habitat.—Indigenous to North America ; in the Southern States it is a tall tree about 50 feet in height.

Characters.—As imported it is in large branched pieces with portions of the stem attached ; frequently the bark is detached, it varies in size and colour from reddish-brown to yellowish-white. The bark, if detached, is in curved pieces more or less flat, of a rusty brown colour, finely striate on the inner surface, soft and fragile. The wood is spongy, of a dull reddish-brown, porous and light, and composed of numerous annulated layers. Odour of the root fragrant and agreeable ; taste aromatic, sweetish, and astringent.

Composition.—Sassafras root contains a volatile oil, sassafrid, tannin, starch, and resin.

The Essential Oil is obtained by distilling the root with water. It is principally prepared in Maryland, where the tree is found in abundance. In preparing the oil the

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entire roots are chopped up, mixed with water, and then distilled. The oil is a pale yellow liquid, becoming brownish-red with age, it sinks in water, and is readily soluble in alcohol; nitric acid colours it red and finally converts it into a resin. It contains a neutral hydrocarbon safrene, $C_{10}H_{16}$, a phenol probably eugenol, and safrol or sassafras camphor, $C_{10}H_{10}O_2$, the latter being the principal constituent.

Sassafrid is obtained by first exhausting the root with ether and then with alcohol; on evaporating the alcoholic tincture, and treating the extract with water, tannin is dissolved, leaving the sassafrid. It is an amorphous tasteless powder, of a reddish-brown colour, and is probably a decomposition product of the tannin; it is not found in the fresh root. (Procter.)

Substitutes.—As the odour of sassafras is characteristic of several plants belonging to this natural order, other substances have been supplied in place of sassafras, prominent amongst them being the sassafras nut.

Fabæ Puchury, Puchury beans, Sassafras nuts. The dried cotyledons of *Nectandra Puchury major* and *N. Puchury minor*, plants indigenous to Brazil. They consist of the single cotyledons of the embryo. They are concavo-convex, blackish-brown in colour, from 1 to 2 inches in length, and frequently covered with the wrinkled testa. They have an aromatic taste and odour somewhat resembling sassafras. They contain an essential oil, and about one-fifth their weight of a solid fat, and are principally used for flavouring. The bark of *Atherosperma moschatum* is known as Australian sassafras. It is used in asthma and heart disease.

Therapeutics.—Stimulant and diaphoretic.

Official Preparation.—Decoctum Sarsæ Compositum.

No. 170. Nectandræ Cortex. Bebeeru Bark. (Greenheart Bark.)

The dried bark of *Nectandra Rodiæi*.

Aristolochiaceæ.

Habitat.—A tall tree growing throughout the higher districts of British Guiana.

Characters.—Greenheart bark occurs in flattish heavy pieces, about two feet in length and six inches broad, and a quarter of an inch or more thick, and consists of the liber bark only. It is hard and brittle, the outer surface is of a light greyish-brown, and marked with numerous depressions, the ridges mainly consisting of soft cork. The inner surface is a dark cinnamon brown and roughly striate; it is inodorous; has a bitter and astringent taste; and breaks with a short granular fracture.

Composition.—The bark contains several alkaloids, viz.:—beberine, nectandrine, and sipirine, with a little tannin.

Beberine, $C_{18}H_{21}NO_3$. This alkaloid is identical with pelosine and buxine. It is obtained by exhausting the bark with dilute acid and precipitating with an alkali, collecting the precipitate and digesting in alcohol, which dissolves the beberine. On evaporation it is left as a nearly white amorphous powder; when treated with ether it leaves the insoluble sipirine (Maclagan), which is a red, resinous-like mass.

Nectandrine, $C_{20}H_{23}NO_4$, is insoluble in ether, but readily soluble in chloroform, and when treated with boiling water fuses into an adhesive mass; sulphuric acid dissolves it, and on addition of peroxide of manganese it gives a violet colour.

The alkaloids exist in combination with beberic acid.

Therapeutics.—Astringent tonic.

Official Preparation.—Beberinæ Sulphas.

ARISTOLOCHIACEÆ.

No. 171. *Serpentariæ Rhizoma.* *Serpentary Rhizome.*

Synonym:—*Serpentariæ Radix.*

The dried rhizome and rootlets of *Aristolochia Serpentaria* or *Aristolochia reticulata*.

Aristolochiaceæ.

Habitat.—Indigenous to the United States.

Characters.—Virginia Snakeroot consists of a twisted rhizome about an inch long and an eighth of an inch thick. It is knotty and bent in an undulating manner, bearing on its upper surface the remains of the short stems of previous growth; on the under surface numerous thin long rootlets are matted together; colour dull yellowish-brown; odour camphoraceous and aromatic; taste warm, aromatic, camphoraceous, and slightly bitter. The branching rootlets have a thick cortical layer containing numerous oil cells.

The rhizome of *Aristolochia reticulata* agrees closely with the preceding characters, but it is thicker, with coarser, longer, and less matted rootlets, and is generally known as Texas Snakeroot.

Composition.—The drug contains a bitter principle serpentarin, and an essential oil, besides tannin, sugar, and a resin.

Serpentarin or Aristolochin is best obtained by treating a decoction of the rhizome with lead acetate, then filtering and adding a solution of tannin, which precipitates it; this is then triturated with lead oxide and warm water which removes the serpentarin. It is a yellow, amorphous, bitter powder, soluble in alcohol and water.

The Essential Oil exists in the rhizome to the extent of .5 per cent., and is readily obtained by passing a current of steam through the crushed drug, separating the oil from the distillate and drying it over calcium chloride. It is a light yellow limpid liquid, with a somewhat terebinthinate odour and camphoraceous taste. Texas Snakeroot yields a higher percentage of the oil.

An infusion of the drug rapidly reduces Fehling's solution; this is occasioned by the presence of a peculiar sugar.

Adulterations.—From the careless collection of serpentary rhizomes, several other roots are not unfrequently found mixed with it, amongst which have been noticed those of Ginseng, Hydrastis, Spigelia, and *Cypripedium pubescens*; careful attention to the characters of the serpentary rhizomes renders the additions easily recognisable.

Thymelaceæ.

Therapeutics.—Aromatic stimulant.

Official Preparations.—Infusum Serpentariæ ; Tinctura Cinchonæ Co. ; Tinctura Serpentariæ.

THYMELACEÆ.**No. 172. Mezerei Cortex. Mezereon Bark.**

The dried bark of *Daphne Mezereum* or of *Daphne Laureola*.

Habitat.—Indigenous to Europe. *Daphne Laureola* is also found in Asia Minor.

Characters.—Mezereon bark, which is usually collected during the winter, is in long, thin, more or less flattened strips, which are folded with the outer surface inwards, or rolled into flattish discs ; occasionally it is in quills a foot or more in length. The thin bark varies in colour externally from reddish-brown to pale yellow or yellowish-brown, with a coppery hue, and is marked with numerous black warts or leaf scars ; internally silky and white, the hairy appearance being due to loose bast fibres. When fresh it has a disagreeable odour, but becomes inodorous on drying ; when chewed it has a burning and acrid taste. Moistened with water and applied to the skin it produces vesication. The root bark is of a slate colour and does not possess leaf scars.

Composition.—Mezereon bark contains a glucoside daphnin, and characteristic fatty resin which is more or less volatile.

Daphnin, $C_{31}H_{34}O_{19}$.—This glucoside is isomeric with æsculin, and differs from arbutin in being precipitated by lead acetate. It is prepared by first decolorising a decoction of the bark with neutral lead acetate, filtering, and adding to the filtrate basic acetate of lead, collecting the precipitate and suspending it in water, then passing a current of sulphuretted hydrogen through the solution, finally decanting the clear solution and carefully evaporating to dryness. The residue is then washed with ether, which

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removes impurities, and is recrystallised from water or alcohol. It is disagreeably bitter but not acrid to the taste, and is readily decomposed with dilute acids or ferments into daphnetin and glucose; alkalies colour it yellow, and it partly sublimes without decomposition.

Daphnetin, $C_9H_6O_4$, H_2O , is readily obtained by heating an alcoholic extract of the bark for some time, then evaporating to dryness, exhausting the dark residue with water, decolorising with lead acetate, evaporating to dryness, and exhausting with alcohol (Stünkel). It crystallises from alcohol in yellow prisms, and has an odour not unlike coumarine. It has been synthesised by heating together pyrogallol and malic acid with strong sulphuric acid.

The Resin, which is apparently composed of a viscid, vesicating oil and a soft resin, remains in solution after precipitation of the daphnin; it is partly volatilised with steam. When an extract of mezereon is submitted to dry distillation it yields amongst other products a considerable amount of umbelliferone (Zwenger).

Substitutes.—The bark of *Daphne Gnidium* or Spurge Flax is collected in France. It is of a darker brown colour, and spirally marked with leaf scars, but in composition closely resembles mezereon bark.

The bark of the root of the three species is the strongest, but seldom found in commerce.

Therapeutics.—Rubefacient. The ointment is employed for keeping blisters open.

Official Preparations.—Decoctum Sarsæ Co.; Extractum Mezerei Etherium.

EUPHORBIACEÆ.**No. 173. Cascarillæ Cortex. Cascarilla Bark.**

The dried bark of *Croton Eluteria*.

Habitat.—A native of the Bahama Islands. The bark is chiefly exported from the port of Nassau, Bahamas.



N^o 173.



N^o 174.



N^o 175.



N^o 186.



N^o 180



N^o 186.



N^o 182.

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Characters.—Cascarilla bark is in quills or channelled pieces, two or three inches in length, and about half an inch or less in diameter. Externally it is covered with a thin greyish-brown easily detached suberous layer, which is marked with a silvery lichen (*Verrucaria albissima*) marked with black dots (*perithecia*). In the older pieces it is transversely fissured and more rugose; the inner surface is smooth and brownish-grey; fracture short, resinous, the broken surface exhibiting numerous oil and resin cells. Odour fragrant and aromatic, particularly when burned; taste aromatic, warm, and bitter.

Composition.—The bark contains a volatile oil, a bitter principle, and a resin, with a little tannin, wax, and starch.

The Essential Oil exists to the extent of nearly 1 per cent.; it is colourless at first, but becomes darker on keeping, and consists of an oxygenated and neutral hydrocarbon, $C_{10}H_{16}$ (Gladstone).

Cascarillin, $C_{12}H_{18}O_4$ (Mylius), is obtained from a decolorised decoction by agitating with ether, in which it is readily soluble, from which it crystallises in colourless micaceous crystals. Strong sulphuric acid dissolves it with a red colour, from which it is precipitated in green flocculi on addition of water (Trommsdorff).

The Resin is composed of two bodies, one of which is readily soluble in alkalies.

Allied Barks.—The barks of *Croton Cascarilla* and *C. lucidus* are sometimes collected at the same time. The latter bark is fawn coloured, thicker in proportion, closely ridged on the inner surface, and has a strong astringent taste, but no aroma.

Copalchi bark is obtained from *Croton Niveus*, a tree indigenous to Mexico. It is sometimes met with in the London market in larger and thicker quills a foot or more in length. On removing the reddish-brown suberous layer it is found to be marked with transverse pits. It contains an alkaloid soluble in ether (Howard).

Therapeutics.—Aromatic tonic.

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Official Preparations.—Infusum Cascarillæ; Tinctura Cascarillæ.

No. 174. Tiglii Semen. Croton Seed.

The ripe seeds of Croton Tiglium (Tiglium officinale).

Habitat.—Indigenous to India and the Philippine Islands. Cultivated in many East India islands and in Japan.

Characters.—Croton seeds are about half an inch long and nearly the same in breadth, oblong or ovoid, flattened on the ventral side, divided longitudinally into two unequal halves, along the surface runs the light-coloured raphe from the hilum, terminating in a black point, the chalaza. Externally the seeds are marked with a light brown coating, underneath which may be seen the thin, black, and brittle testa enclosing an oily kernel, covered with the thin endopleura. The oily perisperm contains the thin foliaceous cotyledons and radicle. The seed is inodorous; taste oily at first, afterwards acrid. The fruit is a trilocular schizocarp containing three seeds.

Composition.—Croton seeds contain from 40 to 60 per cent. of a fatty vesicating oil, which is the principal constituent.

The Fatty Oil is prepared in India, England, and America, that prepared in England being the best. It is obtained by submitting the kernels, after removal of the testa, to pressure between rollers; occasionally slight heat is applied. In America the seeds are crushed, then packed in bags and dipped in boiling water; the oil as it rises to the surface is skimmed off. English croton oil is of a deep reddish-brown or sherry colour, the Indian oil being a pale yellow. It is slightly fluorescent, viscid, and has a faint peculiar rancid odour, with an acrid, burning taste. It is freely soluble in chloroform and ether, and in an equal volume of alcohol, .800, but on a further addition a separation takes place (Senier). It is slightly acid to test-paper, and becomes more viscid on exposure to the air, depositing fatty acids. It is composed of the glycerides of numerous fatty acids and one of the formula $C_9H_{14}O_2$.

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After saponification, the soap yields on decomposition the volatile acids, acetic, butyric and valerianic, as well as the fatty acids, stearic, palmitic, and lauric. Tiglinic acid was obtained by Frölich and Geuther, and crotonic acid by Schlippe, who likewise isolated crotonol. Senier has shown that the portion of the oil which separates on addition of alcohol contains the purgative principle, whilst the portion soluble in alcohol contains the vesicating constituent, which he supposed to be an acid of the oleic series.

Allied Oil.—The seeds of Palilo, obtained from *Croton morifolius*, yield a powerful purgative oil similar to the above (Duges and Armendarès).

Therapeutics.—A drastic purgative.

Official Preparation of the Oil.—Linimentum Crotonis.

No. 175. Ricini Semen. Castor Oil Seed.

The ripe seed of *Ricinus communis*.

Habitat.—A native of Southern Asia, cultivated in Egypt, Italy, and largely in the United States.

Characters.—The fruit resembles that of the croton plant, and contains three seeds. The seeds vary in size, the largest being an inch in length, broad, flattened on the ventral side, smooth; the shining grey-coloured epidermis is variegated with numerous brown, yellow, or reddish-brown spots and lines. The flat ventral side is marked by a prominent raphe running from the large tumid caruncle situated near one end; on removing the caruncle or strophiole, it leaves a black scar just above the hilum. The testa is hard and brittle; the endopleura white and thin, with a brown coloured chalaza; it encloses the white oily perisperm, which contains the cordate cotyledons and short cylindrical radicle. When the kernel is chewed it has a bland oily taste, very faintly acrid.

In Italy two varieties are cultivated, viz., the red-seeded American and black-seeded Egyptian.

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Composition.—The seeds contain a peculiar product analogous to emulsin, a fatty oil, and a substance called ricinine.

Ricinine was first isolated by Tuson, who claims for it the properties of an alkaloid; but from more recent researches, Werner failed to get the usual reactions characteristic of an alkaloid. It is obtained from an aqueous decoction of the seeds by freeing from oil, evaporating and treating the extract with alcohol, in which it is soluble, and from which it crystallises on concentrating the solution. Wayne isolated a similar body from the leaves, but states that it is not an alkaloid.

The product analogous to emulsin is obtained by agitating an aqueous infusion of the seeds with ether, and then precipitating with alcohol. It decomposes amygdalin, with production of oil of bitter almonds and hydrocyanic acid (Werner).

The Fatty Oil is the principal and most important constituent of the seeds, and exists to the extent of 50 per cent.

Preparation.—The seeds are first freed from their integuments by gently crushing and then winnowing, after which they are submitted to powerful pressure in hydraulic presses. By cold pressure they yield about 30 per cent., when heat is used they yield as much as 45 per cent. of a darker oil. It is frequently submitted to treatment with a mixture of recently calcined magnesia and purified animal charcoal, after which it is filtered; by this treatment it becomes nearly inodorous and colourless. Castor oil is a viscid colourless or pale straw-yellow liquid, with scarcely any odour, and a mild, faintly acrid, and unpleasant taste. It is entirely soluble in an equal volume of glacial acetic acid, absolute alcohol, or ether, it is neutral to test paper, but on exposure becomes faintly acid, and dries up after a time to a transparent varnish. It is readily saponified by alkalies, yielding a white soap; when distilled it yields œnanthol, $C_7H_{14}O$, leaving a black residue readily soluble in caustic potash. The oil is composed of glycerides of several fatty acids, the principal being ricinic or ricinoleic

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acid, a thin yellow liquid, yielding with nitrous acid, ricinelaïdic acid, which crystallises in silky needles. Cœnanthol, or cœnanthylic aldehyd, $C_7H_{14}O$, is obtained by distilling the oil with lime; it is a thin, limpid liquid, with an agreeable ethereal odour, readily oxidised into cœnanthic acid.

Reactions of Castor Oil.

- | | |
|--|-----------------------|
| 1. On addition of acid solution of mercury nitrate | } = Yellowish orange. |
| 2. The same on standing twenty minutes | |
| 3. Hydrochloric acid containing sugar (Vidau) | } = Orange yellow. |
| | |

Therapeutics.—A mild cathartic.

No. 176. Kamala. *Kamala.*

A powder which consists of the minute glands and hairs obtained from the surface of the fruits of *Mallotus Philippinensis* (*Rottlera tinctoria*).

Habitat.—Kamala grows throughout India, Arabia, Ceylon, Eastern China, Australia, and Eastern Africa.

Collection.—The capsular fruits are collected and placed in baskets standing on a coarse cloth. The fruits are then well rubbed with the hands to divest them of the hairs and glands, after which the baskets are vigorously shaken, when the powder falls through on to the cloth. The powder is principally shipped from Kurrachee and Bombay.

Characters.—Kamala is a fine granular powder of a brick-red or madder colour, resinous in appearance, and is tasteless and inodorous. Water has little or no effect upon it even when boiling, but macerated in alcohol it forms a deep red solution; alkalies, chloroform, and ether form similar solutions. Microscopically examined the glands are seen to consist of a thin membrane containing numerous yellow-coloured masses of club-shaped vesicles containing a red substance; the hairs are simple, thick, and stellate.

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Composition.—Kamala contains about 80 per cent. of resin and a little tannin.

The Resin, which is best extracted with ether, yields a portion soluble in alcohol, having the formula $C_{15}H_{18}O_4$, and leaves a residue $C_8H_{12}O_5$ (Leub). Both are hard, brittle substances, readily soluble in alkalies, with a red colour.

Rottlerin, $C_{22}H_{20}O_6$ (Anderson), is obtained by carefully evaporating an ethereal extract of fresh Kamala, but from examination recently made, this substance was not obtained from an ethereal extract.

On incinerating a sample it ought not to leave more than 10 per cent. of ash, B.P., or 6 per cent. P.G. and P.U.S. When pure it affords only 1·37 per cent. of ash.

Adulteration.—Of late years kamala has been systematically adulterated, sometimes with red bole or powdered red brick, and occasionally with the dried and powdered flowers of *Carthamus tinctorius*. Three samples recently examined gave respectively 43·2, 36·5, and 50 per cent. of ash, principally insoluble in hydrochloric acid, and consisting chiefly of silica.

Uses.—In India and this country it is principally used for dyeing silks an orange brown.

Therapeutics.—A powerful anthelmintic.

No. 177. Euphorbium. *Euphorbium*.

(*Not official.*)

A gum resin obtained from the stem of *Euphorbia resinifera*.

Habitat.—The plant is a native of Morocco, growing on the lower slopes of the Atlas Mountains.

Collection.—The gum-resin is obtained by incising the stems or fleshy branches, when it exudes as a milky juice, which quickly hardens on exposure, generally incrusting the spines. It is collected towards the end of summer, the mouths and nostrils of the collectors being covered with a cloth to keep out the intensely irritating dust.

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Characters.—Gum euphorbium is in small irregular pieces, about half an inch in diameter, usually with two or three small holes, caused by the spines of the plant. It is of a brownish-yellow colour, with a glossy, waxy appearance; brittle and translucent; inodorous, but when crushed the powder produces prolonged and violent sneezing. Taste strongly acrid and burning, and when triturated with water it yields a white emulsion.

Composition.—Euphorbium contains a peculiar body euphorbon, a resin, gum, and malic acid in combination with sodium and calcium.

Euphorbon, $C_{15}H_{24}O$ (Hesse), is obtained by treating the gum-resin with petroleum ether, and allowing the ethereal extract to evaporate spontaneously. The crystalline residue is treated with hot alcohol, decanted, and on the solution cooling, the resin separates; this is then removed, and on further standing euphorbon crystallises out. It is freely soluble in ether, chloroform, and glacial acetic acid; it dissolves in sulphuric acid with a brownish-yellow colour, changing on addition of nitric acid to violet.

The amorphous resin is readily soluble in cold alcohol, and imparts to an aqueous decoction an acrid and bitter taste.

Gum euphorbium contains from 20 to 25 per cent. of euphorbon, and from 35 to 48 per cent. of resin.

Commerce.—It is now largely shipped from Mogadore, and is used in coating metal and other work used in marine architecture.

PIPERACEÆ.**No. 178. Piper Nigrum. Black Pepper.**

The dried unripe fruits of *Piper nigrum*.

Habitat.—Indigenous to India; introduced and largely cultivated in Java, Borneo, Sumatra, the Philippine and West Indian Islands.

Collection.—The Pepper Vine grows to a height of 30 feet, and is carefully trained by the natives; it bears

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numerous spikes of monœcious or diœcious flowers. As soon as the spikes of fruits commence to turn from green to red or reddish-brown they are removed; the next day the berries are removed by rubbing with the hands; they are then dried either by exposure to the sun, or placed in baskets, which are hung over a gentle fire.

Characters.—Black pepper berries are globular, and about one-fifth of an inch in diameter; the pericarp is deeply wrinkled, and reticulated, thin and blackish-brown or greyish-black in colour, containing a hard, smooth, globular seed of a light yellowish-brown colour. Odour aromatic; taste pungent, hot, and bitterish.

Composition.—Pepper contains an alkaloid, a volatile oil, and an acrid resin, besides starch and gum.

Piperin, $C_{17}H_{19}NO_3$, is prepared by first making an alcoholic extract; this is then washed with water, after which it is digested in alcohol with a little slaked lime, then filtered, and concentrated, when it crystallises out. It is purified by being redissolved in alcohol, digested with animal charcoal, filtered, and recrystallised (Wittstein). When pure it crystallises in colourless four-sided prisms; tasteless at first, afterwards somewhat peppery. It is insoluble, or nearly so, in water; soluble in ether, alcohol, and chloroform, and melts at about $100^{\circ}C$. into a yellow oily liquid, which on cooling forms a resinous mass. Strong sulphuric acid dissolves it, forming a yellow, and, finally, a green-brown solution (Dragendorff). Nitric acid colours it yellow, finally a red resin is formed, which, with caustic potash, gives a blood-red colour. Pepper contains from 4 to 9 per cent. of piperine.

Piperidine, $C_5H_{11}N$, is obtained when piperin is boiled with caustic potash, or distilled from soda-lime. It is a clear, yellow, strongly alkaline fluid, with the odour of ammonia and pepper. It readily neutralises acids forming crystalline salts, and it is soluble in alcohol or water.

Piperic Acid, $C_{12}H_{10}O_4$, is obtained from the potash solution, after removal of the piperidine, by adding hydrochloric acid, collecting the precipitate, and crystallising

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from alcohol. It crystallises in yellow needles, sparingly soluble in water.

Chavicin is obtained from the residue previously exhausted with alcohol and water by percolating with ether, agitating the ethereal extract with potash, separating, and removing the ether by distillation (Buchheim). On decomposition it yields piperidine and chavivic acid.

The Essential Oil is isomeric with turpentine, it is colourless, and has the odour of pepper, but no pungent taste.

The Resin is of a dark green colour, it has a very pungent and biting taste.

Pepper, on incineration, ought not to yield more than 5 per cent. of ash.

Adulterations.—Whole Pepper is frequently mixed with the stalks which supported the fruit, and artificial peppercorns have been found to the extent of 20 per cent. They are made from pepper dust, oilcake, clay, and cayenne pepper (Chevallier).

Ground Pepper is frequently adulterated with linseed meal, mustard husks, ground rice, sand, pepper leaves, rape seed, chicory, &c. A careful examination with the microscope is the best means of detection, coupled with the percentage of ash.

Other Peppers.—Piper Album, White Pepper, consists of the ripe fruit of the *Piper nigrum*, which has been immersed in water and afterwards divested of its pericarp by rubbing. It consists of the seed covered by the thin white inner covering of the fruit.

White pepper is rather larger than the black, and not quite so pungent. It is principally imported from Telli-cherry in Malabar.

Piper Longum consists of the dried spikes of *Chavica officinarum* and *Chavica Roxburghii*. The former is a native of Java and Sumatra, the latter of India and Ceylon and the Philippines. They are the full grown but still immature fruits, and agree in odour, taste, and composition, with black pepper.

Therapeutics.—A stimulant stomachic.

Piperaceæ.

Official Preparations.—Confectio Opii ; Confectio Piperis ; Pulvis Opii Compositus.

No. 179. Cubebæ. *Cubebs.*

The dried unripe full-grown fruit of *Piper Cubeba* (*Cubeba officinalis*).

Habitat.—Indigenous to Sumatra and Java.

Collection.—The plant is cultivated chiefly on coffee plantations, where advantage is taken of its large bushy growth as a shade for the more tender coffee shoots. When the spikes have acquired their full size, they are carefully removed, dried by exposure to the sun, and the fruit is removed with the small stalk still adhering to it.

Characters.—Cubebs are globular and of the size and appearance of black pepper, tapering at the base into a rounded stalk, which is continuous with, and permanently attached to, the pericarp ; the apex is somewhat pointed from the remains of adherent stigmas. After removing the epicarp, a hard brown endocarp is found, forming a shell which encloses the seed in the mature fruit ; as met with in commerce, many of the fruits have a shrunken seed. The fruit has a warm and aromatic odour, increased on crushing the fruit ; taste aromatic and pungent, slightly bitter.

Composition.—Cubebs contain a crystalline substance cubebin, a resin, cubebic acid, a volatile oil, gum, and a fixed oil.

Cubebin, $C_{10}H_{10}O_3$, crystallises from an ethereal extract of cubebs in white pearly scales or needles, melting at 260° F. Strong sulphuric acid colours it blood-red ; it is sparingly soluble in ether, readily in chloroform ; when fused with caustic potash it yields protocatechuic and acetic acids. Cubebs contain from .5 to 2.5 per cent. of cubebin (Schmidt).

The Resin, which is present to the extent of about 3 per cent., is best obtained from the fruit after removal of the essential oil : it is readily extracted by alcohol. The

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alcoholic solution is treated with lead acetate to remove cubebic acid and filtered, the filtrate treated with a current of hydrogen sulphide and evaporated to dryness. It is readily soluble in alkalies and alcohol, sparingly in ether and chloroform.

Cubebic Acid constitutes 25 per cent. of the crude resin. It is prepared from the precipitated lead salt by suspending it in alcohol and decomposing with a current of hydrogen sulphide. Cubebic acid, $C_{14}H_{16}O_4$, and cubeb resin dissolve in strong sulphuric acid, forming a red coloured liquid; like the resin it is an amorphous substance.

The Essential Oil is obtained by distilling the crushed fruits with a current of steam, the yield varying from 5 to 15 per cent. The rectified oil is colourless, has a warm, aromatic taste, and dissolves in strong sulphuric acid, which, on warming, becomes red. It is composed of a neutral hydrocarbon and a camphor, $C_{30}H_{48}2H_2O$, the neutral hydrocarbon cubebene having the formula $C_{30}H_{48}$ (Ogialoro).

Adulterations.—Cubebæ are sometimes mixed with the small stalks which supported the fruit; occasionally black pepper has been found, but more as an accidental than intended adulteration. Recently a more serious adulteration has been found to a considerable extent, consisting of the fruits of *Piper crassipes* (*Cubeba crassipes*), and those of the lauraceous plant, *Daphnidium Cubeba*. The following characters distinguish them from true Cubebæ:—

Piper crassipes.—The stalk is more flattened and the berry lighter in colour and larger. Odour resembling mace; taste bitter; microscopically the endocarp is composed of ten rows of cells instead of four (Kirkby). An infusion, when cold, gives a purple colour with iodine; an ethereal extract, on evaporation, is of an olive-green colour, and when a portion of it is treated with strong sulphuric acid it gives a brown colour, and, if nitric acid is then added, it changes to green, fading to yellow.

Daphnidium Cubeba.—The stalk is generally absent; if present, it is found to be articulated. Taste lemon-like, then bitter. An ethereal extract has a brown colour, and

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is scarcely affected with sulphuric acid or with sulphuric and nitric acid, giving a faint brown. An infusion is not altered on the addition of iodine; an infusion of true cubebs with iodine gives an indigo-blue colour.

Therapeutics.—Cubebs are principally used for their influence on the mucous membrane of the urethra and bladder.

Official Preparations.—Oleo-resina Cubebæ; Oleum Cubebæ; and Tinctura Cubebæ.

No. 180. Maticæ Folia. Matico Leaves.

The dried leaves of *Piper angustifolium* (*Artanthe elongata*, *Piper elongatum*).

Habitat.—Indigenous to the forests of Tropical South America.

Characters.—As found in commerce matico is frequently mixed with the fruits and flowers. The leaves are from 3 to 8 inches in length, oblong-lanceolate, tapering towards the apex, cordate and unequal at the base; the margin is entire or finely crenulate; the petiole very short. The leaves are thick, with sunken veins; the upper surface uneven or tessellated, and of a faded green colour; the under surface downy, with prominent veins. As generally seen, the leaves are compressed into a brittle mass, which on breaking has a somewhat aromatic odour; taste aromatic and bitterish. The flower spikes are about 4 inches in length, with the flowers crowded together, the stalk thin and cylindrical. The fruit small and black.

Composition.—Matico contains a crystalline acid, resin, volatile oil, and a little tannin.

Artanthic Acid is isolated from the resin by treating it with weak caustic potash, and finally precipitating it by the addition of hydrochloric acid. It crystallises readily from alcohol (Marcotte).

The Resin is intensely acrid and pungent, and is left, after removing the alcohol, as a bright red residue.

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The Essential Oil. The leaves yield nearly 3 per cent. of this oil, which is dextro-rotatory. When fractionated the greater part distils over at 200° C. The residue, on cooling, deposits crystals of matico-camphor. On treating the camphor with hydrochloric acid it gives a violet colour, changing to blue, then green (Kugler).

Substitutes.—The leaves of several plants are used in South America in place of matico. Of these may be mentioned the leaves of *Piper lanceæfolium*, *Waltheria glomerata*, and *Eupatorium glutinosum*.

Adulteration.—*Piper aduncum*. The leaves closely resemble those of matico, but differ in not being tessellated, and in being thinner and less hairy; their properties are the same. These leaves sometimes occur mixed with matico in commerce.

Therapeutics.—Styptic.

Official Preparations.—*Infusum Maticæ*.

SALICACEÆ.**No. 181. *Salicis Cortex.* Willow Bark.**

The dried bark of *Salix alba* and other species, viz. *S. Caprea*, *S. Russelliana*, and *S. fragilis*.

Habitat.—Indigenous to Europe.

Characters.—Willow bark occurs in quills or fragments of quills; externally it is smooth and covered with a thin corky layer, which in young bark is shiny, but in old pieces is covered with numerous round corky warts. It varies in colour from brown to grey; the inner surface is smooth and of a pale cinnamon-brown colour. It breaks with difficulty, but may be torn in shreds longitudinally; it has a slightly bitter and astringent taste, and is, when dry, inodorous. The bark is best collected in the spring, when it is more easily removed from the wood.

Composition.—Willow bark contains salicin, tannin, gum, and wax.

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The tannin gives a black coloration with ferric chloride, and is a glucoside, and with sodium hydrate gives a red solution (Johanson).

Salicin, $C_{13}H_{18}O_7$, is prepared by digesting a concentrated decoction with litharge for some time, filtering and passing a current of sulphuretted hydrogen through the solution, again filtering, evaporating, and setting aside to crystallise. The crystals are dissolved in alcohol, decolorised with animal charcoal, filtered, and evaporated to a low bulk, and set aside to crystallise. Salicin is in colourless plates or prisms, soluble in water and alcohol, and its aqueous solution is not precipitated by tannin or Mayer's reagent. Strong sulphuric acid dissolves it with a bright red colour, after a time, depositing rutilin, a red powder. Strong nitric acid dissolves it, finally oxidising it into helicin and helicoidin; when heated with dilute sulphuric acid and bichromate of potassium salicylol distils over, which has a fragrant agreeable odour of meadow-sweet. Boiled with dilute sulphuric acid it yields saligenin, $C_7H_8O_2$, and glucose, the former on prolonged boiling giving saliretin, $C_{14}H_{14}O_3$.

Johanson also obtained traces of benzohelicin in willow bark.

Allied Barks.—The bark of different species of *Populus* is also employed in making salicin, the different varieties being *P. alba*, *P. fastigiata*, *P. nigra*, and *P. tremula*. Besides containing salicin they contain populin or benzoylsalicin, which has an acrid taste.

Official Preparation.—Salicin.

ULMACEÆ.

No. 182. Ulmi Cortex. *Elm Bark.*

(*Not official.*)

The dried inner or liber bark of *Ulmus campestris*.

Habitat.—Indigenous to Europe.

Characters.—Elm bark is generally collected in spring, and then freed from the rough external suberous layer, after

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which it is dried. The inner bark is found in pieces of various sizes, flat, and of a rusty-brown colour externally; the inner surface smooth, of a pale-brown colour, and finely striate. It is tough and fibrous, and breaks with difficulty; it is inodorous, with a feebly astringent and mucilaginous taste.

Composition.—Elm bark contains a considerable amount of mucilage and traces of tannin. The spontaneously exuded gum found on the tree, and which darkens on exposure to the air, is incorrectly called ulmin. The bark also contains small quantities of a bitter principle; the tannin gives a dark-brown precipitate with ferric chloride.

Allied Barks.—Slippery Elm bark is obtained from the *Ulmus fulva*, a tree indigenous to the United States. This bark is generally in long strips about three inches broad and two or three feet in length; it principally differs from elm bark in having a peculiar fœnugreek-like odour. It contains a large quantity of mucilage.

The Black Elm, *Ulmus effusa*, also furnishes a small amount of elm bark.

ARTOCARPACEÆ.**No. 183. Ficus. Fig.**

Synonym:—*Fructus Caricæ.*

The dried fruit of *Ficus Carica*.

Habitat.—Indigenous to Asia Minor; it is also cultivated in the warmer districts of Europe and America.

Characters.—The fig consists of the thick, succulent, hollow receptacle, which is pear-shaped and erroneously called a fruit; it bears on its inner surface numerous seed-like achenes. The receptacle is marked at its apex by a round orifice, which is usually surrounded by a few scales; when unripe it is green, and contains an acrid juice, which has a sweet taste on ripening. Figs have a fruity odour and sweet agreeable mucilaginous taste. The large pulpy figs, which are the best, are known as Smyrna or Turkish figs;

Moraceæ and Cupuliferae.

the small figs, of inferior quality, which are often strung on cord, are known as Greek figs.

Composition.—Figs principally contain grape sugar, which not unfrequently amounts to 70 per cent. by weight of the fruit; they also contain gum and about 16 per cent. of moisture.

Official Preparation.—Confectio Sennæ.

MORACEÆ.**No. 184. Mori Fructus. Mulberries.**

The ripe fruit of *Morus Nigra*.

Habitat.—Indigenous to Asia Minor, and cultivated throughout Europe.

Characters.—The mulberry tree bears unisexual catkins, the female catkin is ovoid in form, and, through the coalescence of the overlapping calyces, the fruits as they ripen resemble a compound berry about an inch in length, oblong, and of a purple colour, having an agreeable sub-acid taste. When pressed they yield a dark violet or purple juice, which is almost inodorous.

Composition.—Mulberries vary in composition according to their age. The juice yielded to Wright and Patterson, glucose, citric, and malic acids.

Official Preparations.—Succus Mori and Syrupus Mori.

CUPULIFERÆ.**No. 185. Quercus Cortex. Oak Bark.**

The dried bark of the smaller branches and young stems of *Quercus Robur* and *Quercus pedunculata*.

Habitat.—Indigenous to Great Britain.

Characters.—The bark is collected in spring, and varies in its appearance according to age. As usually met with, it is in channelled pieces or quills, from a few inches to



N° 185



N° 201.



N° 200.

(*Juniperus communis*)

Cupuliferæ.

two feet in length, and about one-tenth of an inch thick. The external surface is smooth, shiny, grey or greyish-brown in colour, and marked with scars; the inner surface is rusty brown in colour, and ridged, the fracture fibrous and tough. It has a feeble odour, and an astringent taste.

Composition.—Oak bark contains a characteristic tannin, a terpene resin, and phlobaphen.

Quercitannic Acid, $C_{17}H_{16}O_9$ (Etti). This acid is not identical with the tannic acid of galls, as it does not yield pyrogallol but pyrocatechin on distillation. It exists in oak bark in two forms, as the pure acid, which is reddish-white, and as the anhydride phlobaphen, which is brownish-red. The quercitannic acid obtained by treating an alcoholic extract of the bark with acetic ether is still contaminated with the terpene resin and phlobaphen. The mass is treated with anhydrous ether, which removes the resin, after which it is digested with acetic ether; this removes the tannin, leaving the phlobaphen. Quercitannic acid, when heated or boiled with dilute sulphuric acid, yields several anhydrides, one of which is oak-red. Oak bark contains about 11 per cent. of quercitannic acid.

Phlobaphen, $C_{34}H_{30}O_{17}$, yields catechol on dry distillation; its solution in alcohol gives a characteristic brown-red with lead acetate. It is insoluble in water and ether.

Therapeutics.—Astringent.

Official Preparation.—Decoctum Quercus.

No. 186. Galla. Galls.

Synonym:—Nut Galls.

Excrescences on *Quercus Lusitanica*, var. *infectoria*, caused by the puncture and deposit of an egg or eggs of *Cynips gallæ-tinctoriæ*.

Habitat.—*Q. Lusitanica* is a shrubby plant indigenous to Asia Minor, Greece, and several of the islands in the Mediterranean.

Cupuliferae.

Formation.—Galls are produced on numerous plants, but different varieties of oak seem to be more liable to the visits of these insects than many other trees. The female insect pierces the young bark with its ovipositor, and then deposits one or more eggs in the wound; the local irritation produced by this operation causes the formation of an excrescence which encloses the larvæ, which ultimately hatch within the gall.

Characters.—Galls are hard, heavy, and subglobular, from half an inch to three quarters of an inch in diameter, more or less tuberculated on the surface. They are a deep olive-green or bluish-green colour externally, and brown or greyish-brown internally; the fractured surface has a resinous lustre. Galls are inodorous; taste strongly astringent, afterwards sweetish. In commerce Aleppo galls are considered the best.

Composition.—Galls contain gallic and gallotannic acids, resin, and sugar.

Gallotannic Acid is contained in the best oak galls to the extent of 70 per cent. It is freely soluble in water and alcohol, insoluble in absolute ether, and its aqueous solution gives a precipitate with gelatine, and a deep blue colour with ferric chloride. On heating, it yields pyrogallol, and its solution, boiled with caustic soda or dilute sulphuric acid, yields gallic acid; this latter reaction explains its constitution as digallic acid.

Gallic Acid exists naturally in galls to the extent of about 3 per cent. It differs from tannic acid in not precipitating gelatine solution.

Official Preparations. — Acidum Gallicum; Acidum Tannicum; Tinctura Gallæ; Unguentum Gallæ; and Unguentum Gallæ cum Opio.

Allied Galls.—Chinese and Japanese galls are produced on the leaves and leaf stalks of *Rhus semialata* by the insect *Aphis Chinensis*. They are very irregular in form, thin, and appear as if stalked; towards the middle and apex a few protuberances occur. The shells are covered with a fine down, and when broken numerous remains of

Santalaceæ.

dead insects are found. They contain from 70 to 80 per cent. of tannin.

English Galls, obtained from the *Quercus Robur*, are small and of a pale colour, and rarely contain more than 12 per cent. of tannin.

Valonia consists of the acorn cups of several species of oak found growing in the countries bordering the Mediterranean, but chiefly of *Quercus Ægliops*.

SANTALACEÆ.**No. 187. Santali Lignum. Sandal Wood.**

The heart-wood of *Santalum album* and probably other species.

Habitat.—The white sandal-wood tree and other members of this genus are found distributed amongst the East Indian Islands, Tropical Asia, and Australia.

Collection.—The tree is carefully protected by the Government in the forests of Mysore, where it is principally produced, and only those trees which have arrived at maturity are allowed to be felled. The tree having been felled—this taking place usually at the end of the year—it is freed from its branches and bark, and either allowed to lie on the ground for some time, in which case the white ants destroy nearly all the inodorous alburnum, or this portion of the stem is removed by means of an axe. The trunk is then cut into billets of different lengths. The roots are also dug up, trimmed, and yield a valuable wood; it is also largely used for the preparation of the oil.

Characters.—As met with in commerce, white sandal wood occurs in billets nearly four feet in length, and from 6 to 10 inches in diameter. It is hard and heavy, colour varying from a pale yellow to a light reddish-brown; taste aromatic; odour agreeable and persistent, increased on powdering or warming the wood. The billets split somewhat easily, the concentric zones are darker towards the inside, and porous. Examined under the microscope numerous oil and resin cells are visible.

Santalaceæ.

Composition.—The duramen alone yields the essential oil ; it is not contained in the younger alburnum, or bark. Besides the essential oil, the wood contains a resin and tannic acid, the latter giving a green colour with neutral ferric chloride.

Varieties of Sandal Wood.—There are several members of the genus *Santalum* which yield the sandal wood of commerce, amongst which the following may be mentioned :—

<i>Santalum Freycinetianum</i>	}	From Pacific Islands.
„ <i>pyrularium</i>		
„ <i>insulare</i>		
„ <i>Cunninghami</i>		
„ <i>Austro-Caledonicum</i>	„	New Zealand.
<i>Fusanus spicatus</i>	}	„ Australia.
<i>Exocarpus latifolia</i>		

No. 188. Oleum Santali. Oil of Sandal Wood.

The oil distilled from the wood of *Santalum album*.

It is distilled in some quantity in Mysore, but the bulk is principally distilled in Germany. It is occasionally distilled in this country.

Preparation.—In India the wood, preferably of the root, is cut up into small pieces or chips, and about forty or fifty pounds placed in the still ; this is then covered with water and slowly distilled, a fresh supply of water being occasionally added ; in about ten or twelve days the distillation is complete. The distillate is allowed to stand for a short time, and the oil is then removed. As imported, it is frequently in a discolored condition, and adulterated with fixed oils. The wood varies in its yield from 1·5 to 2·5 per cent., that obtained from the root being of better and finer quality (*Bidie*).

Characters.—Sandal wood oil is thick in consistence, of a pale yellow colour, possessing in a marked degree the aromatic odour and pungent taste of the wood. Its specific gravity varies somewhat ; according to W. H. Ince ·9797 to

Santalaceæ.

·9650 is the limit between which the true oil varies. The oil is neutral, or only faintly acid in reaction, readily soluble in alcohol in all proportions, and in an equal volume of alcohol sp. gr. ·920; when old its solubility is somewhat lessened, and it is darker in colour.

Composition.—As sandal wood oil may be prepared from different sources it is not always constant in composition. Chapoteau fractionated a sample of this oil, and obtained two portions, one, $C_{15}H_{24}O$, boiling at 570° F., and the other, $C_{15}H_{26}O$, boiling at 590° F. On distilling these fractions with phosphoric anhydride the hydrocarbons, $C_{15}H_{22}$ and $C_{15}H_{24}$, were obtained, the latter closely resembling that of oil of copaiba.

Adulterations.—Sandal wood oil is frequently the subject of sophistication; fixed oils, and oils of cedar wood or copaiba are those most frequently met with, whilst a sample lately examined contained a notable quantity of alcohol. In India the oil is frequently adulterated with the oil of rose geranium.

Tests.—Fixed oils and oil of copaiba will considerably reduce the specific gravity and diminish the solubility of the oil in alcohol sp. gr. ·920. Agitated with strong solution of chloride of zinc, sandal oil should gelatinise. Oil of cedar wood will also diminish the sp. gr., and will render the oil insoluble in an equal volume of alcohol, ·920 (Ince). Agitated with an equal volume of strong solution copper ammonium hydrate, and then diluted with four volumes of water, on standing some time it should give a white soap; if cedar oil is present a green soap will result.

Allied Oils.—West Indian “Sandal wood oil.” This is not obtained from a species of *Santalum*, but according to a recent examination by E. M. Holmes, the plant yielding this oil probably belongs to the *Rutaceæ*. The wood of this plant is totally different from that of *Santalum album*, and contains no oil (Kirkby). This oil is prepared by distilling the bark; it is dextro-rotatory, and is somewhat fluorescent, and the specific gravity slightly above that of true sandal oil.

Hamamelidæ.

Oil of Cedar Wood is obtained by distilling the shavings and chips of the wood of *Juniperus virginiana* and perhaps other species. The oil is of a pale yellowish colour, sp. gr. .94, and requires five times its volume of alcohol .920, for solution.

HAMAMELIDÆ (Liquidambaraceæ).**No. 189. *Styrax Præparatus.* Prepared Storax.**

A balsam prepared from the inner bark of *Liquidambar orientalis*, and purified by solution in spirit, filtration, and evaporation.

Habitat.—Indigenous to south-western Asia Minor.

Production.—The outer bark is first removed from the tree, and is generally reserved for use in the preparation of incense; the inner bark is then carefully scraped off by means of a blunt instrument, and is placed in pits until a considerable quantity has been obtained. The scrapings are either submitted to pressure and then treated with hot water (Maltass), or they are boiled with water, and the resin, as it rises to the surface, is skimmed off, the residue being then squeezed in a wooden press, and the semifluid resin usually collected in barrels.

Purification.—Storax is purified by melting it with rectified spirit, straining the solution, and then recovering the spirit; according to Biel nearly 70 per cent. is lost in this way, so that he prefers dissolving the balsam in warm benzol, filtering, and recovering the benzol; by this method 90 per cent. is obtained. More recently Schlickum recommends treating the storax with a mixture of alcohol and ether, filtering, and recovering the solvent, the yield from a good sample being 70 per cent.

Characters.—Liquid storax is a semi-transparent, or, in thin layers, transparent, brownish-yellow, viscid balsam of the consistency of honey. When heated it becomes more liquid, and from the crude drug small globules of water will separate; when ignited it burns with a bright flame.

Hamamelida.

It has an agreeable odour and balsamic taste ; it is soluble in carbon bisulphide, ether, and alcohol, the last solution forming a deposit after a time ; it yields to hot petroleum ether about 5 per cent. of its weight, the solution when cool depositing crystals. When boiled with bichromate or permanganate of potassium and sulphuric acid it evolves an odour resembling essential oil of bitter almonds.

Composition.—Storax contains, amongst other bodies, storesin, cinnamic acid, styrol, styracin, and styrogenin.

Cinnamic acid, $C_9H_8O_2$, is readily obtained by gently warming storax with a solution of ammonium or sodium carbonate, filtering the solution, and decomposing with hydrochloric acid, collecting the precipitate, washing with cold water, and finally dissolving in boiling water, from which the acid crystallises on cooling. Storax yields from 5 to 15 per cent. of this acid. When distilled at a dull red heat it yields styrol, benzine, and carbon dioxide.

Styrol, C_8H_8 , is obtained by distilling storax with water and separating the fragrant oily liquid from the distillate, and removing all traces of water by means of calcium chloride. It is a thin, mobile, colourless liquid, sp. gr. .924, and boils at $295^\circ F.$; odour fragrant ; taste warm and pungent. When heated to high temperatures it is converted into a solid polymeride metacinnamene.

Styracin, $C_9H_9C_9H_7O_2$, is obtained from the residue after removal of cinnamic acid and styrol with hot petroleum ether ; the residue is exhausted with ether or alcohol to dissolve the styracin, which deposits in crystalline needles on slow evaporation. The crystals melt at $44^\circ C.$ (Scharling), and on saponification with caustic soda yield styrene or cinnyl alcohol, $C_9H_{10}O$, and sodium cinnamate. On oxidation it gives benzaldehyde and carbon dioxide.

Styrogenin, $C_{26}H_{40}O_3$ (Mylius), is obtained from that portion of storax which is dissolved out by benzine, by treating it first with sulphuric acid, then with water, and finally with ether, when styrogenin is left in white crystals.

Storesin, $C_{36}H_{58}O_3$, is readily soluble in alcohol, and on evaporation is left as an amorphous mass. It is readily

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soluble in potassium hydrate, forming a crystalline salt. It is probably the most abundant constituent of liquid storax.

Adulteration.—Storax is sometimes mixed with earth, pieces of bark, and sand. Purified storax has been found adulterated with turpentine; this is readily detected by agitating with petroleum ether; on the evaporation of the ether the residue should have an agreeable balsamic odour; turpentine, if present, will leave a yellow-coloured residue with the pronounced odour of turpentine.

Allied Drugs.—American storax, obtained from *Liquidambar styraciflua*, is closely related to the liquid storax. It is usually known as “sweet gum,” and is somewhat paler in colour than ordinary storax.

Official Preparation.—Tinctura Benzoini Composita.

CANNABINACEÆ.**No. 190. Cannabis Indica. Indian Hemp.**

The dried flowering and fruiting tops of the female plants of *Cannabis sativa*, grown in India, and from which the resin has not been removed.

Habitat.—Indigenous to Central and Western Asia. As a drug it is principally produced in the districts of Bogra and Rajshahi, north of Calcutta, India, where it is largely cultivated.

Characters.—Indian hemp, as prepared in India, is met with in two forms, viz., Gunjah, Ganja or Guaza, and Bhang. The former is that which the British Pharmacopœia recognises. The term Hashish is the Arabian name for the plant.

Gunjah or *Ganja* consists of the flowering shoots of the female plant, 4 to 8 inches in length, more or less compressed together in masses, of a greenish-brown colour, with a few small leaves, and the remains of a large number of flowers, and a few nearly ripe fruits. It is brittle, with a slightly bitter taste, and a heavy, peculiar narcotic odour.

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Bhang.—This consists chiefly of the dried and broken leaves in the form of a coarse powder. It is of a dark-green colour; odour narcotic and disagreeable. It is principally smoked with or without tobacco, and is also used in preparing confections and beverages.

Charas or *Churrus* consists of the resin which exudes, and is collected by rubbing the matured tops in the hands and scraping off the adhering resin from the fingers. Other methods are also resorted to for the removal of this resin. Charas is a dark-brown, firm, or sometimes friable mass of varying size. It is rarely if ever found in European commerce, being principally used by the natives.

Composition.—Much doubt exists as to what is the active principle of Indian hemp. It contains a volatile oil, resin, and a volatile alkaloid.

The Resin.—This is generally known as Cannabin, and was first obtained comparatively pure by T. & H. Smith. They prepared it by exhausting the ganja first with weak solution of sodium carbonate, then with water, and afterwards with alcohol. The tincture was treated with milk of lime, filtered, and any trace of lime removed with sulphuric acid, again filtered through charcoal, and finally precipitated with water. It is an amorphous mass, which on treatment with hot nitric acid leaves an orange-coloured residue, containing oxycannabin, $C_{20}H_{20}N_2O_7$.

The Volatile Oil, obtained in minute quantity on steam distillation, possesses a disagreeable odour, and, according to Personne, contains cannabene ($C_{18}H_{20}$) and cannabene hydride ($C_{18}H_{22}$). Warden and Waddell obtained by distilling an alcoholic extract with caustic potash an amber-coloured oil, which contained a volatile alkaloid, having a slight resemblance to nicotine, possibly due to the fact that Bhang is sometimes mixed with tobacco. They failed to obtain the tetano-cannabinine said to be present in Indian hemp, and isolated by Hay. Cannabinine, a volatile alkaloid, but which does not possess the properties of nicotine, was obtained by Siebold and Bradbury by distilling the hemp with a strong solution of caustic soda.

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The distillate was neutralised with oxalic acid, evaporated, and then exhausted with alcohol. The oxalate finally saponified with caustic soda, and agitated with ether. It possesses a strong conine-like odour, and readily neutralises acids. The resin is not produced in plants grown in this country. A glucoside with an alkaloidal reaction, introduced by Merck, is now in use in medicine as a hypnotic, under the name of tannato or cannabine.

Official Preparations. — Extractum Cannabis Indicæ; Tinctura Cannabis Indicæ.

No. 191. Lupulus. Hop.

Synonym :—*Strobili Humuli.*

The dried strobiles of *Humulus Lupulus*, from plants cultivated in England.

Habitat.—The Hop is indigenous to Europe, and has been introduced into North America, Australia, and Brazil.

Characters.—Hop strobiles, as found in commerce, are more or less compressed. When unbroken they are a little over an inch in length, ovate or rounded in form, and consist of numerous thin, greenish-yellow or brownish-yellow, membranous, enlarged stipules and bracts, attached to a hairy, irregular glandular axis. These leafy bodies are nearly ovate, glandular at the base, and surround a small achene, having numerous brownish-yellow glands on its surface. Odour when fresh agreeably aromatic, but when kept for some time it becomes unpleasant; taste bitter, slightly astringent, and aromatic. After drying, hops are frequently subjected to the vapour of sulphurous acid gas.

Composition.—Independent of the constituents contained in the glands, hop contains tannin, resin, volatile oil, and alkaloid.

The Tannin, according to Wagner, closely resembles moritannic acid, but is only partially precipitated by gelatine (Bissell). Hop contains about 5 per cent. of this tannin.

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The Volatile Oil obtained by steam distillation amounts to nearly 1 per cent. It is colourless, but becomes dark and acid in reaction on keeping, and consists of a neutral hydro-carbon ($C_{10} H_{16}$) and valerol ($C_6 H_{10} O$), the latter being the source of the valerianic acid.

The Resin is prepared by extracting hops with cold water, and then digesting with charcoal; this removes the resin and bitter principle, from which the resin is extracted by digesting in strong alcohol, filtering, and evaporating, then dissolving the residue in water, agitating with petroleum ether, which removes the resin. On evaporating off the ether, the resin is left as a light-brown amorphous mass.

Hop Bitter is obtained from the aqueous solution after removal of the resin by agitating with ether, which readily dissolves it. It is not a glucoside, but yields lupuliretin on treatment with dilute acids (Isleib).

The Volatile Alkaloid.—Lupuline strongly resembles conine in odour. It is only contained in minute quantities.

Hop on incineration leaves from 6 to 10 per cent. of ash, of which nearly one-half is soluble in water.

Official Preparations.—Extractum Lupuli; Infusum Lupuli; and Tinctura Lupuli.

No. 192. Lupulinum. Lupulin.

A glandular powder obtained from the dried strobiles of *Humulus Lupulus*.

Collection.—Lupulin is usually collected by removing the bracts, then rubbing and shaking them in wicker baskets, after which the powder is separated from coarser particles by means of a sieve. The dried strobiles afford 8 to 12 per cent. of lupulin. Lupulin ought to be washed by decantation to remove sand, and then dried.

Characters.—It consists of numerous globular or ovoid-shaped, reticulated, translucent glands, forming a bright yellow granular powder. When fresh, the glands contain a

Conifera.

brownish-yellow liquid which by age becomes a brown resinous mass. Lupulin burns readily, and has the pleasant aromatic odour and taste of the hop; on incineration it should not leave more than 10 per cent. of ash. When exhausted with ether the insoluble residue should not exceed 30 per cent. by weight, and the ethereal extract should possess the odour of the hop in a marked degree.

Composition.—Lupulin contains an essential oil identical with that of the hop, a bitter principle, wax, and resin.

Lupamaric Acid, $C_{25}H_{35}O_4$ (Bungener). This is the bitter principle, and is obtained by first digesting lupulin in petroleum ether, removing the dark solution, and distilling off the ether; the dark brown residue solidifies on cooling to a crystalline mass, which is purified by several recrystallisations. It is insoluble in water, but readily dissolves in alcohol, ether, or chloroform.

The wax is one of the chief constituents of lupulin, and consists of myricylic palmitate.

The Resin is a complex body separable into two portions, one of which combines with alkalies, forming salts.

Adulteration.—Lupulin is frequently mixed with sand, and some samples consist solely of the sweepings of the storage rooms. Such extraneous matter is easily detected by incineration.

GYMNOSPERMIA.

CONIFERÆ.

No. 193. Oleum Terebinthinæ. Oil of Turpentine.

The oil distilled, usually by the aid of steam, from the oleo-resin (turpentine), obtained from *Pinus australis* (*Pinus palustris*), *Pinus Tæda*, and sometimes *Pinus Pinaster* and *Pinus sylvestris*, rectified if necessary.

Habitat.—*Pinus australis* and *P. Tæda* are large trees, forming, with other members of this genus, huge forests throughout North America, and produce American turpentine.

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Pinus Pinaster, *P. sylvestris* and *P. laricis* are indigenous to Europe, and afford European turpentine.

Secretion.—The resin ducts containing the turpentine are found in the bark and wood of the trees; in some species they reside almost solely in the bark. and in others chiefly in the wood, consequently different methods are resorted to in the collection of the turpentine.

Production.—In North Carolina the operator usually cuts a large hole near the base of the trunk, technically known as a *turpentine box*. These holes vary in shape and capacity, some holding nearly a quart; the box being completed, the bark and a thin layer of the wood are cut or hacked, and from this wound the oleo-resin exudes, and collects in the box; the hacking is repeated from time to time above the old wounds, until they reach a height of about 20 feet. After this the other side of the tree is tapped in the same way, and the process is repeated. The turpentine or dip is collected and conveyed to the distilleries, where it is poured into large copper stills, and heat applied. The distillate is removed, and the oil separated from the water and transferred to barrels, in which it enters commerce. The residue is run out from the still and constitutes rosin.

Purification.—As oil of turpentine of commerce is frequently impure, it is rectified by redistillation from water or preferably from slaked lime, the residue from this operation being used in soap manufacture.

Characters.—Rectified oil of turpentine is a thin, colourless, limpid, volatile liquid, its density varying from .85 to .87. The two varieties of this oil differ somewhat in their physical properties. Bordeaux oil of turpentine is lævogyre; American and German oil, dextrogyre; the boiling point varies between 150° and 170° C.; taste pungent and bitterish; odour feeble, but stronger on keeping. Iodine acts on it with violence, evolving hydriodic acid and leaving cymene; nitric acid decomposes it, forming numerous acids; gaseous hydrochloric acid unites with the oil, and forms a mono-hydrochloride, the so-called artificial camphor.

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Composition.—Oil of turpentine consists of a neutral hydrocarbon $C_{10}H_{16}$ terebinthine; which, on distilling from sulphuric acid, yields terebene, $C_{10}H_{16}$, and a polymer, colophene, $C_{20}H_{32}$.

Adulteration.—Oil of turpentine is sometimes adulterated with Russian turpentine or rosin oil. As both these products are complex mixtures of bodies closely related to terebinthinene, but differ in their odour, sp. gr., and boiling point, a careful examination of the character of true turpentine is the best means of detection.

Allied Products.—Russian oil of turpentine. This oil is obtained by distilling the roots of different species of *Pinus*, particularly *Pinus sylvestris* and *P. Ledebourii*. The oil so obtained contains the products of the destructive distillation of the wood as well as the resin. Its chief characters consist in the great absence of uniformity of sp. gr., boiling point, and optical power.

Terebene, $C_{10}H_{16}$. This is a product obtained by sulphoning terebinthinene at a temperature of $80^{\circ}C$., then separating the oil and distilling from carbonate of sodium or slaked lime. When pure it is optically inactive, and boils at about $170^{\circ}C$.

Official Preparations.—*Confectio Terebinthinæ*; *Enema Terebinthinæ*; *Linimentum Terebinthinæ*; *Linimentum Terebinthinæ Aceticum*; and *Unguentum Terebinthinæ*.

No. 194. Resina. Resin.

Synonyms:—*Rosin, Colophony.*

The residue left after the distillation of the volatile oil or turpentine.

Characters.—Resin is of different degrees of colour. This is partly due to the age of the oleo-resin. The first flow yields a residue of a pale yellow colour, and as age increases it changes to a yellowish-brown, and finally brown. When the oil has been distilled at high temperature, the residue constitutes black resin. White or amber resin is a translucent yellowish brittle mass, easily

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pulverisable; having a shiny fracture; terebinthinate odour and taste. It is soluble in glacial acetic acid, strong alcohol, ether, and alkalies, and melts at about 100° C. Yellow resin is opaque from the presence of water.

Composition.—Resin consists almost entirely of the anhydride of abietic acid, $C_{44}H_{64}O_5$, into which it is readily converted by solution in warm dilute alcohol. Treated in this way it yields 85 per cent. of its weight. Abietic acid can also be obtained by digesting resin in strong solution of ammonia, filtering, and precipitating with a mineral acid. Pinic or sylvic acid are impure forms of this acid.

Resin, when destructively distilled, yields rosin oil, which contains numerous hydrocarbons, fatty acids, and colophene. It is largely used in the arts in preparing varnishes and paints.

Official Preparations.—Charta Epispastica; Emplastrum Calefaciens; Emp. Cantharidis; Emp. Picis; Emp. Plumbi Iodidi; Emp. Resinæ; Emp. Saponis; Unguentum Resinæ; and Ung. Terebinthinæ.

No. 195. Thus Americanum. *Common Frankincense.*

The concrete turpentine which is scraped off the trunks of *Pinus australis* and *Pinus Tæda*.

Habitat.—North America.

Characters.—This turpentine is met with in two conditions: semi-fluid and solid. Semi-fluid turpentine is a viscid, honey-like liquid, opaque, and of a light yellow colour. On exposure to the air it becomes transparent; on keeping it separates, the crystalline deposit being abietic acid. Solid Turpentine, or Frankincense, is a soft, yellow, semi-opaque substance, with the odour and taste of turpentine; it consists of the turpentine which has naturally dried on the tree. By keeping it becomes dry and brittle, darker in colour, and milder in odour. Galipot, or Barras, is the corresponding product obtained in France from *Pinus maritima*.

Coniferae.

Composition.—Frankincense consists principally of abietic acid, with varying proportions of volatile oil; and Galipot consists of Pimaric acid.

Official Preparation.—Emplastrum Picis.

No. 196. Oleum Pini Sylvestris. Fir-wood Oil.

The oil distilled from the fresh leaves of *Pinus sylvestris*.

Habitat.—The *Pinus Sylvestris* is found growing in Scotland, Finland, Russia, and Germany.

Preparation.—The leaves and young twigs are collected and distilled by steam, the light oil is separated from the distillate and filtered. A large quantity of this oil is prepared commercially by distilling the wood.

Characters.—Fir-wood oil is colourless, or of a faint straw yellow colour; neutral in reaction when fresh, but becoming darker in colour and acid on keeping. It has an aromatic, fragrant odour. Taste pungent and unpleasant. It requires seven times its volume of rectified spirit for complete solution; the specific gravity should not be below .870.

Composition.—According to Tilden it consists of two neutral hydrocarbons, isomers of terebinthinene. In its reactions it closely resembles turpentine.

Therapeutics.—Antiseptic, vermifuge, diuretic.

Official Preparation.—Vapor Olei Pini Sylvestris.

No. 197. Terebinthina Canadensis. Canada Turpentine.

Synonym:—*Canada Balsam.*

The turpentine obtained by puncturing or incising the bark of the trunk and branches of *Pinus balsamea* (*Abies balsamea*).

Habitat.—The balsam fir is indigenous to Canada and the Northern United States.



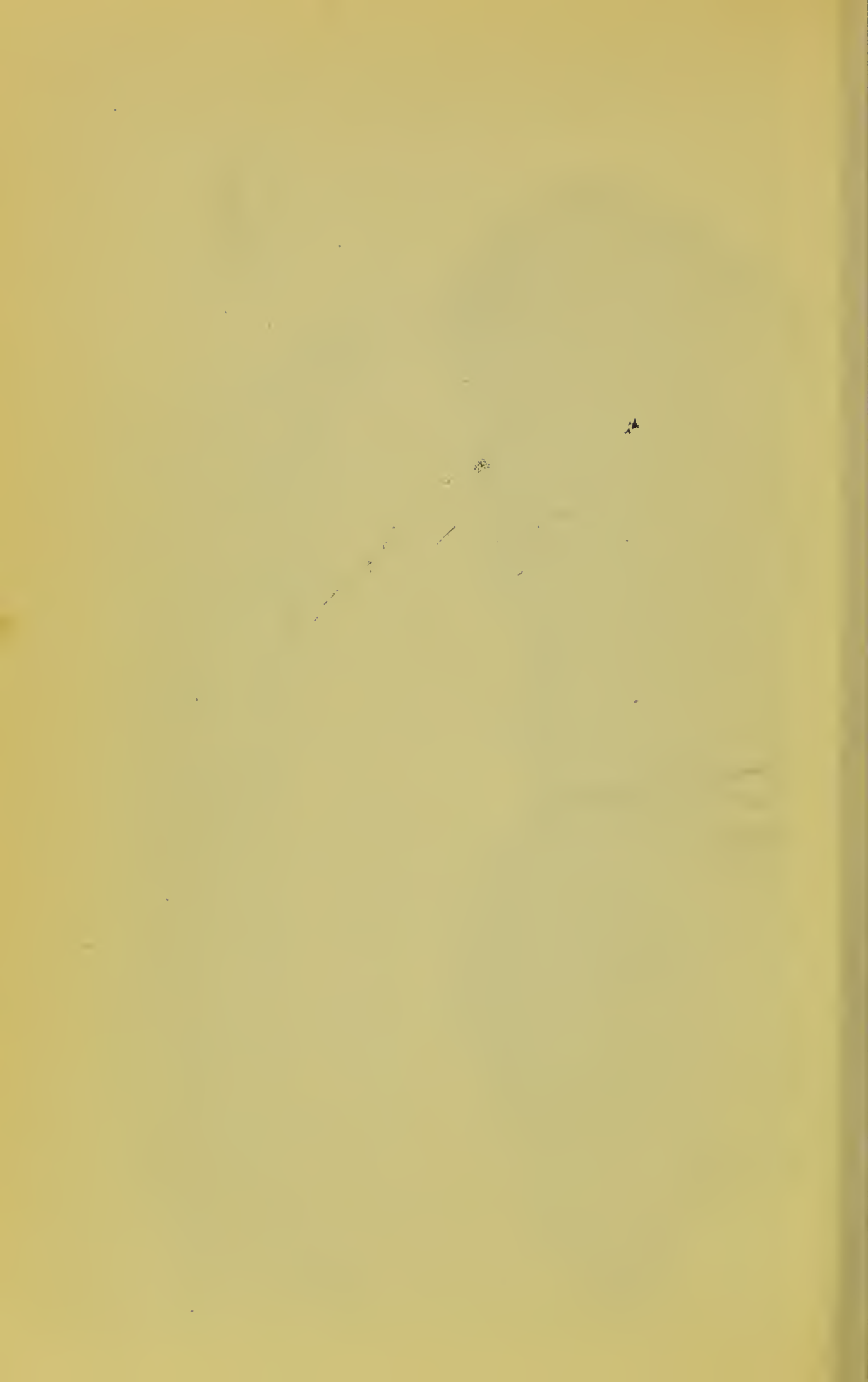
N° 202.



N° 204.



N° 210.



Coniferae.

Collection.—This species secretes the turpentine chiefly in the bark. In collecting the turpentine the operator pierces the vesicles with a sharp pointed tube forming a spout to a tin vessel, into which it flows. The trees are allowed a rest of three or four days before they are again punctured. A tree yields about half a pint at a time. Canada turpentine is principally collected in the province of Quebec.

Characters.—Canada turpentine is a pale yellow or faintly green tinted, transparent, slightly fluorescent, viscid liquid; odour agreeably terebinthinate; taste somewhat bitter and acrid. On exposure it dries up, forming a transparent mass. It is readily soluble in chloroform or ether, and incompletely so in glacial acetic acid or absolute alcohol.

Composition.—It consists of a volatile oil and resin, which is slightly different from that of other turpentines.

The Volatile Oil constitutes about 20 per cent. of the turpentine, and is closely related to terebinthinene, but differs in containing a minute quantity of an oxygenated oil.

The Resin, when treated with warm alcohol, does not yield any abietic acid, but the greater portion is soluble in alcohol, the residue readily dissolving in ether.

Adulteration.—Canada turpentine is sometimes adulterated with the so-called Oregon balsam, which is a mixture of resin and turpentine.

Official Preparations.—Charta Epispastica and Collodium Flexile.

No. 198. Pix Burgundica. Burgundy Pitch.

The prepared resinous exudation obtained from the stems of *Pinus Picea* (*Pinus Abies*; *Abies excelsa*).

Habitat.—*P. Picea*, the Norway Spruce Fir, is indigenous to Central and Northern Europe.

Production.—Burgundy Pitch is collected in Switzerland, Germany, Austria, and Finland. It is collected by

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making short, deep incisions into the trunk of the tree and collecting the turpentine as it exudes. It is then purified by melting in hot water and straining. The strained mass is heated for a short time to expel moisture.

Characters.—Burgundy Pitch is in hard, brittle masses of a dull yellowish or reddish-brown colour. It is opaque, and breaks with a conchoidal fracture, the fractured surface having an agreeable balsamic odour, which is increased on heating. Taste aromatic and devoid of bitterness. It is readily soluble in glacial acetic acid, strong alcohol, or acetone.

Composition.—Burgundy Pitch contains an essential oil isomeric with terebinthinene, the resin consists principally of abietic acid, and a portion which is amorphous.

Adulteration.—As met with in English commerce, Burgundy Pitch consists of a mixture of turpentine, resin, fat, and palm oil, which are melted together, and water stirred in to render the mixture opaque. When warmed with glacial acetic acid it forms a turbid mixture.

Official Preparations.—Emplastrum Ferri and Emplastrum Picis.

No. 199. Pix Liquida. Tar.

A bituminous liquid obtained from the wood of *Pinus sylvestris* and other species of *Pinus* by destructive distillation.

Habitat.—The bulk of the tar is prepared in Russia, Finland, and Sweden.

Preparation.—Pine wood which is unfit for timber is cut into logs and piled up in stacks, so arranged as to produce slow draughts, and ignited. The combustion is regulated so that flame is scarcely visible, the products pass downwards, and are collected in a cavity made for the purpose. A more economical process is to submit the wood and roots to distillation in iron retorts, whereby all the products are obtained.

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Characters.—Tar is a dark-brown or blackish viscid liquid, transparent, with an empyreumatic odour, and pungent bitter taste. After standing for some time it deposits aggregations of crystals of pyrocatechin; when agitated with water the solution is of a brown colour, acid in reaction, and sharp taste.

Composition.—Tar consists of a complex mixture of hydrocarbons, acids, phenols, and paraffins. When fractionally distilled the light oil contains acetic acid, methyl alcohol, acetone, toluol, xylol, phenol, creasol, and naphthalene. The heavy oil, which was examined by Reichenbach, was found to contain cedriret, pittacal, and picamar.

Allied Products.—Juniper Tar, Huile de Cade. This product was originally obtained by destructively distilling the wood of *Juniperus oxycedrus*; that which is now met with in commerce is principally obtained from the common juniper wood.

Official Preparation.—Unguentum Picis Liquidæ.

No. 200. Fructus Juniperi. Juniper Fruit.

The dried full-grown unripe green fruits, fleshy galbuli, of *Juniperus communis*.

Habitat.—Indigenous to Europe.

Characters.—Juniper fruits are globular, of a dark purple colour when ripe, but green during the first year. They are usually composed of three succulent carpellary leaves, which become united together, the union being marked by a tri-radiate groove at the apex; these enclose three hard seeds which are partially attached to the base of the leaves. Towards the base of the seed there are situated several prominent sacs containing oil. The fruit has an aromatic odour, with a sweet balsamic taste.

Composition.—The fruit contains a volatile oil, sugar, resin, juniperin, wax, and pectin, malic, formic, and acetic acids.

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Juniperin is a pale yellow substance, readily soluble in alcohol or ether, and also in ammonia, forming a bright yellow solution.

The Volatile Oil is obtained by mixing the crushed fruit with salt and water, and then distilling. The fruit yields from .5 to 2 per cent. of volatile oil. The oil is almost colourless or of a pale greenish tint; the sp. gr. varies between .85 and .90; the oil consists of a mixture of hydrocarbons isomeric with terebinthinene.

Commerce.—Juniper fruit is principally collected in Austria, and on a smaller scale in Savoy and Italy.

Therapeutics.—Diuretic.

Official Preparation of the Oil.—Spiritus Juniperi.

No. 201. Sabinæ Cacuminæ. Savin Tops.

The fresh and dried tops of *Juniperus Sabina*. Collected in spring from plants cultivated in Britain.

Habitat.—It grows throughout the greater portion of Europe, and in some districts of North America.

Characters.—Savin tops consist of young, thin, angular twigs, densely covered with minute, imbricated, adpressed, dark green (or, when dried, yellowish-green) leaves, with an oval depressed central gland at their back. Odour persistent and strong; taste bitter and disagreeable. The savin of commerce is frequently mixed with the fruits (galbuli) about the size of a pea, which contain from one to four seeds.

Composition.—Savin tops contain an essential oil, tannin, resin, and chlorophyll.

The Volatile Oil is the most important constituent of the plant, and is obtained by distilling the fresh branches with steam, the yield being about 2.5 per cent. The fruits yield 10 per cent. of the same oil. It is generally of a pale yellow colour, possessing in a marked degree the odour and taste of the plant. It dissolves in absolute alcohol in all proportions; when powdered iodine is added,

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energetic action ensues, sometimes accompanied by detonation. According to Tilden, it is composed of two portions, one being an oxygenated body of the formula $C_{10}H_{16}O$.

Therapeutics.—Emmenagogue. The ointment forms a stimulating dressing for blisters.

Official Preparations.—Oleum Sabinæ; Tinctura Sabinæ; Unguentum Sabinæ.

No. 202. Laricis Cortex. Larch Bark.

The bark of Pinus Larix (Abies Larix). Collected in spring, deprived of its outer rough portion, and dried.

Habitat.—Indigenous to the forests of Southern and Central Europe, and grown to a considerable extent in Scotland and England.

Characters.—The bark is in flattish pieces or quills, of varying sizes and lengths. A large portion of that taken from the older wood, consisting of the suberous layer, exfoliates, leaving the exposed surface of a roseate hue and uneven. The inner surface is smooth, yellowish-white or pinkish-red, fracture fibrous. Odour balsamic and terebinthinate; taste astringent.

Composition.—Larch bark contains a tannin, resin, and larixinic acid.

The Tannin exists in larch bark to a considerable extent; its solution gives an olive-green precipitate with ferric chloride, and on boiling with dilute sulphuric acid it becomes red, but yields no sugar.

Larixinic Acid, or Larixin, is obtained by carefully concentrating a hot infusion, and then distilling it. The acid volatilises and condenses in the neck of the retort, from which it is removed and purified by sublimation. It has the formula $C_{10}H_{10}O_5$, and is closely related to pyrogallol.

Therapeutics.—Astringent and styptic.

Other Products of the Larch.—Terebinthina Veneta, Venice Turpentine. This is obtained by boring a hole into the centre of the trunk, after which it is closed up for some

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time and then opened; the turpentine is then removed by means of a spoon. It is a thick, viscid liquid, which on exposure to the air slowly dries, forming a clear varnish. Venice turpentine is rarely imported into England; what is used is a mixture of rosin and turpentine.

Official Preparation.—Tinctura Laricis.

Class II. MONOCOTYLEDONS.**ZINGIBERACEÆ.****No. 203. Zingiberis Rhizoma. *Ginger Rhizome.***

The scraped and dried rhizome of *Zingiber officinale* (*Amomum Zingiber*).

Habitat.—Indigenous to tropical Asia, where it is also cultivated on a large scale. It has been introduced into several tropical countries, and is cultivated largely in South America, Australia, the West Indian Islands, and Tropical Africa.

Production.—Commercial ginger is met with in two forms, and is known under the names of coated or uncoated. The pieces of the rhizome are called *hands* or *races*. Coated ginger consists of the rhizomes, from which, after removal from the ground, the remains of the leaves are removed by paring; they are then washed, and very slightly scraped on the flattened sides, and dried either in the sun or by means of a slow fire.

Uncoated or scraped ginger consists of the rhizomes, which are first washed, then freed from the remains of the leaves, scraped by means of a blunt knife, rewashed, and finally dried in the sun. It is sometimes submitted to the fumes of burning sulphur, or large tubs are filled with the fresh scraped rhizomes, and then filled up with a solution of chlorinated lime; after soaking in this solution for some time, they are removed, washed with cold water, and dried. As met with in commerce it is frequently coated with a white layer. This arises from the method adopted

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of whitening the ginger by dipping the pieces into milk of lime or a thin cream of gypsum and water.

Characters.—Coated ginger occurs in pieces from 2 to 8 inches in length, of a brown colour externally, slightly annulated from the remains of the leaf bases, wrinkled, and somewhat shrivelled in appearance; internally of a dark colour; the fractured surface is horny and resinous. It is sometimes known as black ginger.

Uncoated or scraped ginger is met with in flattish, irregularly branched pieces; of a pale-buff colour externally, smooth, and striated. The pieces vary in length, but are generally about 4 inches long. It breaks readily, and the fractured surface is mealy and fibrous; the colour is pale yellow. The odour of ginger is agreeable and aromatic; the taste strong, pungent, and aromatic.

Composition.—Ginger contains several resins, an essential oil, gingerol, traces of an alkaloid, starch, and mucilage.

The Resins.—These bodies, and the other constituents of ginger, were isolated and examined by Dr. Thresh, who separated the resins into three portions. No. 1, Neutral resin. This is the chief constituent of the resin, and has the formula $C_{16} H_{24} O_3$. It is odourless and tasteless, soluble in strong alcohol, ether, and turpentine. When fused with caustic potash it yields a crystalline acid, which gives a green colour with ferric chloride. The proportion of this resin varies, as do all the other constituents of ginger, according to the source. It ranges between .86 to 2.3 per cent. The remaining portion of the resin was of an acid character, and when treated with carbon disulphide separated into two portions; the insoluble portion is called resin *a*, and the soluble one resin *b*.

Resin a ($C_{46} H_{54} O_{10}$) is a brittle solid, of a jet-black colour, readily soluble in dilute alcohol, chloroform, and in potassium hydrate solution, forming a dark-brown solution; it is precipitated from this solution on addition of ammonium chloride, and forms insoluble salts with lead.

Resin b ($C_{43} H_{60} O_8$) closely resembles the preceding resin, but differs in its insolubility in carbon disulphide. It

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forms an orange-coloured solution with potash. It is soft, of a reddish-brown colour, odourless, and tasteless.

The Essential Oil, which can be obtained by distilling an extract, or preferably the ground rhizomes, with steam, is contained in some samples to the extent of nearly 2 per cent. It is of a pale straw yellow colour, with a camphoraceous odour and aromatic taste; sparingly soluble in alcohol, readily in chloroform, ether, or glacial acetic acid. Strong sulphuric acid dissolves it with a blood-red colour; nitric acid acts upon it with explosive violence. Commercially, there are two kinds of this oil, English and foreign. They vary in their specific gravity. "Foreign" oil being .9, and "English" .883, at 63° F. The oil becomes darker on exposure to the air, and after a time acquires an acid reaction. It is a complex mixture of hydrocarbons and their oxidized products. It contains a hydrocarbon, $C_{15}H_{24}$, cymene, terpene, and when crude, formic and acetic acids.

Gingerol is obtained from the alcoholic solution after removal of the resins with lime, on carefully evaporating the residue. It is purified by treatment with hot petroleum ether, and quickly decanting, when it deposits in oily drops on cooling. It is a pungent, viscid fluid, of a pale straw colour, odourless, but strongly pungent and of a bitterish taste. Gingerol is alkaline in reaction, darkens when heated, and is decomposed with boiling water; nitric acid converts it into a blood-red resinous mass.

The mucilage is soluble in water, and is not affected by solution of borax, and only very slightly so by neutral lead acetate or ferric chloride.

Ginger on incineration yields from 3.5 to 5 per cent. of ash.

Commerce.—Ginger is largely imported from Jamaica, Cochin China, the West Coast of Africa, Egypt, and India. Jamaica ginger is usually esteemed as the best, and yields a yellowish powder.

Therapeutics.—Carminative.

Official Preparations.—Confectio Opii; C. Scammonii; Infusum Sennæ; Pilula Scillæ Co.; Pulvis Cinnamomi Co.;

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P. Jalapæ Co.; P. Opii Co.; P. Rhei Co.; P. Scammonii Co.; Syrupus Zingiberis; Tinctura Zingiberis; Tinct. Zingiberis Fortior; Vinum Aloes.

No. 204. Cardamomi Semina. Cardamoms.

The dried ripe seeds of the Malabar Cardamom, *Elettaria Cardamomum*.

Habitat.—The plant is indigenous to Hindostan, and is largely cultivated in the forest of Mysore, and at Coorg and Wynaad on the Malabar coast.

Productions.—The cardamoms are collected during the dry season. The fruits are borne on a scape, which is gathered when only a portion of them are ripe. The scapes are laid out on trays, and after two or three days the fruits are removed, and are then completely dried, either in the sun or by means of a gentle heat.

Characters.—The fruits are of an ovoid or oblong shape, three-sided, and rounded at the base, varying in length from a quarter to one inch, and in commerce are divided into shorts, short-longs or mediums, and longs. The capsule is three-valved, terminating in a beaked apex, the pericarp is thin and leathery; from the middle of each projects a thin septum, forming three loculi, containing about 8 seeds arranged in two rows.

The seeds are about one-sixth of an inch long, irregularly angular, transversely rugose, with a depressed hilum, and a deeply grooved raphe. The seed is enclosed in a thin, membranous, nearly colourless arillus; the embryo is club-shaped, with the radicle pointing towards the hilum, and is surrounded with a more or less granular perisperm. Externally they are of a dark reddish-brown colour, but whitish within, with an aromatic and warm taste; odour agreeably aromatic.

Composition.—Cardamom seeds contain an essential oil, a fixed fatty oil, a colouring principle, starch, and gummy matter.

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The Essential Oil is obtained by distilling the crushed seeds with water, or by passing a current of steam through the mass; the aqueous distillate also contains acetic acid. The seeds yield nearly 5 per cent. of this oil. It is colourless or of a pale yellow, and possesses in a high degree the odour and taste of the seeds. Sp. gr. about .93. It contains neutral hydrocarbons and a solid camphor, $C_{10}H_{16}(H_2O)_3$. When treated with iodine or nitric acid it is decomposed energetically. The fatty oil is obtained by pressure, or by percolating the crushed seeds with ether. The seeds contain about 11 per cent.

Cardamoms on incineration leave about 15 per cent. of ash, which contains a notable quantity of manganese.

Varieties of Cardamoms.

Ceylon Cardamoms are obtained from *E. Cardamomum*, var. major. They are nearly an inch and a half in length, with a long pointed apex. These are frequently imported.

Bengal Cardamoms, from *Amomum aromaticum*, are about an inch in length, and the fruit has nine narrow wings, the apex terminating in a nipple. The fruits are of a dark brown colour.

Java Cardamoms, from *Amomum maximum*, are an inch to an inch and a half in length, with four wings, apex terminating in a tube.

Round or Siam Cardamoms, from *Amomum Cardamomum*, are globular, and about the size of a small cherry. The seeds have a strong camphoraceous taste. The last three varieties come only occasionally into the London market.

Therapeutics.—Carminative.

Official Preparations.—Extractum Colocynthis Co.; Pulvis Cinnamomi Co.; P. Cretæ Aromaticus; Tinctura Cardamomi Co.; Tinct. Gentianæ Co.; Tinct. Rhei; Vinum Aloes.

No. 205. Curcumæ Rhizoma. Turmeric.

The dried rhizome of *Curcuma longa*.

Habitat.—Indigenous to Southern Asia, largely cultivated in British India and the East Indian Islands.

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Characters.—As met with in commerce, turmeric is found in two forms, the round and long. The central portion of the rhizome usually becomes thickened, and sends off numerous lateral shoots, which usually become fusiform and thickened towards their apex. Round turmeric consists of the central portion; it is about two inches in length, and is either globular, pyriform, or oblong, and generally pointed at the upper end. It is marked externally with numerous annulated scars. It is of a dull yellowish-grey colour externally, and breaks with a resinous fracture; the fractured surface is of a brown-yellow colour, which is darker towards the centre; the odour is aromatic; the taste is warm, aromatic and bitterish. Long turmeric occurs in cylindrical pieces, somewhat curved and annulated, and consists of the lateral rhizomes.

Composition.—Turmeric contains an essential oil, curcumin, a viscid oil, resin, gum, and starch.

The Essential Oil is obtained to the extent of nearly one per cent. by distilling the rhizome with water. It consists of an oxygenated hydrocarbon ($C_{10}H_{14}O$), which is probably isomeric with thymol (Suida and Daube), and a neutral body.

Turmeric Oil is obtained by percolating the drug with light petroleum ether. On evaporation it is left as a viscid yellow oily liquid, with an aromatic odour. When fractionated under diminished pressure it yields turmerol (Jackson and Menke). Turmerol is a pale yellow oil. Sp. gr. .90 at $17^{\circ}C$. It has a pleasant aromatic smell; it is readily soluble in alcohol, chloroform, or ether. Turmerol ($C_{19}H_{28}O$) is an alcohol, and yields on oxidation terephthalic acid.

Curcumin ($C_{14}H_{14}O_4$) is obtained by first removing the oil from the rhizome by means of carbon disulphide, then percolating with ether, and allowing the ethereal solution to evaporate; the residue is purified by washing with cold ether, dissolving in hot alcohol, from which it crystallises in yellow prisms on cooling. Curcumin is an acid, and when treated with oxidising agents yields vanillin. An alcoholic solution boiled respectively with sulphuric

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and boric acids, yields with the former rosocyanin, and with the latter pseudo-curcumin (Schomberger). Boracic acid colours it brown, which is changed to red on addition of an alkali.

Commerce.—Turmeric is imported from various Asiatic countries, and the varieties met with in commerce are known as Chinese, Bengal, Madras, Cochin-China, and Java. They differ somewhat in their colour and appearance. Zedoary root is obtained from *Curcuma Zedoaria*.

Official Preparation.—*Tinctura Curcumæ*.

No. 206. Galangæ Rhizoma. Galangal.

(*Not official.*)

The rhizome of *Alpinia officinarum*.

Habitat.—It is indigenous to Southern China and the island of Hainan, where it is also cultivated.

Characters.—The rhizome occurs in pieces about two inches in length, occasionally branched, and marked with numerous raised irregular rings. It is of a rusty brown colour externally, paler internally, and breaks with a fibrous fracture. Odour agreeable and aromatic, with a taste resembling that of ginger.

Composition.—Galangal contains a volatile oil, galangin, alpinin, galangol, and kampferid.

The Essential Oil is obtained by steam distillation, and amounts to about .5 per cent. It is a pale yellow colour when first prepared, but becomes brown on keeping. According to Vogel it has the composition of $C_{10}H_{16}H_2O$.

Galangin, $C_{15}H_{10}O_5H_2O$ (Jahns), crystallises from its dilute alcohol solution in pale yellow needles; when dissolved in sulphuric acid it does not form a fluorescent solution; otherwise it resembles kampferid.

Alpinin, $C_{17}H_{12}O_6$ (Jahns), crystallises in yellow needles. With reagents it gives the same reactions as galangin.

Kampferid, $C_{16}H_{12}O_6$, H_2O , is in yellow needles, which are readily soluble in alcohol or ether, sparingly in water.

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It dissolves in alkaline solution forming an intensely yellow solution; with sulphuric acid it forms a fine blue fluorescent liquid. The above principles can be obtained by first exhausting the drug with petroleum ether to remove the volatile oil and galangol, then exhausting with ether, evaporating, and treating the extract with alcohol.

Galangol is a viscid pale yellow liquid, with an intensely pungent taste. It is readily soluble in alcohol; when oxidised it yields several acids of the fatty series (Thresh).

Galangal also contains starch, mucilage, and tannin.

Galangal when prepared for the market is frequently covered with a red-coloured earth to improve its appearance.

Allied Drug.—Greater Galangal is obtained from *Alpinia Galanga*, a native of Java. It is seldom met with in commerce, and is distinguished from the above by being much longer and thicker, and of a paler colour.

No. 207. Grana Paradisi. *Grains of Paradise.*

Synonym.:—*Semen Melegueta*.

(*Not official.*)

The seeds of the ripe fruit of *Amomum Melegueta*.

Habitat.—Indigenous to the tropical districts of the West Coast of Africa.

Characters.—The seeds are contained in a scarlet coloured fruit about the size of a small pear. They are from one to two lines in diameter, roundish, and angular; the hilum is depressed; they are glossy, and of a reddish-brown colour; the odour is aromatic, and the taste strongly pungent and burning.

Composition.—Grains of Paradise contain a volatile oil, paradol, resins, tannin, and gum.

Paradol is the active constituent of the seeds, and is obtained by exhausting the seeds with petroleum ether, then removing the ether by evaporation, dissolving the residue in spirit and precipitating by lead acetate and

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ammonia. In the filtrate any remaining lead is precipitated by sulphuretted hydrogen; the liquid is then filtered and the filtrate carefully evaporated, and the paradol removed by agitation with chloroform. Paradol was isolated and examined by Thresh, who considers it isomeric with capsaicin; when oxidised it yields carbon dioxide and caproic acid.

The Essential Oil is of a faint yellow colour; it consists of two bodies having the formulæ $C_{10}H_{16}$ and $C_{10}H_{16}O$.

The seeds, like those of cardamoms, contain manganese.

IRIDACEÆ.**No. 208. Crocus. Saffron.**

The dried stigmas and top of the style of *Crocus sativus*.

Habitat.—Indigenous to Persia and Asia Minor. It is largely cultivated at Alicante in Spain, Gatinais in France, and on a small scale in Austria.

Characters.—Saffron crocus has a style nearly four inches in length, but only a part of this is collected, which is the upper divided portion bearing three stigmas, as this alone is coloured; it rarely exceeds one inch in length. The stigmas are thickened and tubular, slit on the inner side, and the margins are notched. Dried saffron is flexible and tough, brownish-red in colour, unctuous to touch; the odour strong and aromatic; taste warm, aromatic, and bitterish.

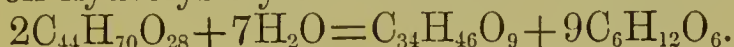
Composition.—Saffron contains an essential oil, crocin, picrocrocine, fat, wax, and albumen.

The Essential Oil is readily obtained by steam distillation in a current of carbon dioxide. It is colourless when first prepared, but becomes dark on standing; it possesses in an intense degree the odour of saffron, and from the more recent researches of Kayser it has the formula $C_{10}H_{16}$.

Crocin or Polychroit, $C_{44}H_{70}O_{28}$ (Kayser), is prepared from saffron which has been first freed from its oil by percolation with ether, and then exhausted with water. The infusion is agitated with purified animal charcoal, the

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charcoal removed and percolated with distilled water, which dissolves the crocin, the solution is evaporated to dryness, and treated with strong alcohol. The alcoholic solution is carefully evaporated, when it is left as a brittle, yellow mass. Strong sulphuric acid dissolves it, forming a blue solution, changing to violet, then red; it is a glucoside, and on hydrolysis yields crocetin and crocose,

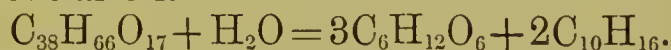


Previous to this examination crocin was said to yield polychroit, glucose, and an essential oil.

Crocetin, $C_{34}H_{46}O_9$, is a red powder, insoluble in water, readily so in alcohol, and gives the same colour reactions as crocin.

Crocose, $C_6H_{12}O_6$. This sugar is dextrogyre, and yields rhombic crystals, and only feebly reduces Fehling's solution.

Picrocrocetin, $C_{38}H_{66}O_{17}$, is obtained by prolonged exhaustion of the saffron with warm ether, from which it crystallises on cooling in prismatic needles. It is readily decomposed; yielding with dilute sulphuric acid, crocose and the essential oil.



Saffron, on incineration, leaves not more than 6 per cent. of ash. It should not lose more than 12 per cent. of moisture when dried at 212° F.

Adulteration.—This drug is very frequently adulterated, but most of the admixtures are easy of detection; amongst the more frequently found additions are the florets of *Calendula officinalis*, cut red poppy petals, and the petals of the pomegranate, stamens of the crocus, and the heavy powder found adhering to the stigmas consists principally of barium sulphate, gypsum, or chalk; these latter are readily detected by the amount of the ash, and examination of its composition. Sometimes the flower of the marigold and other flowers which are used for sophistication, are dyed with dinitrocresylate of sodium. Saffron yields no colour to ether, but the above salt imparts a yellow tint. Saffron should be allowed to macerate in water for a short time, and then carefully examined, when any addition is easily recognised.

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Commerce.—Several commercial names are used to distinguish either the source or variety of the saffron. Gatinais or French saffron is reputed the best, Spanish, Alicante, or Valencia generally contains a large portion of the styles. When loose it is known as hay saffron, and when compressed as cake saffron; the latter as now met with is principally the florets of the marigold. About 50,000 to 60,000 plants are required to yield one pound weight of dry saffron.

Official Preparations.—Decoctum Aloes Co.; Pilula Aloes et Myrrhæ; Pulvis Cretæ Aromaticus; Tinctura Cinchonæ Co.; Tinct. Croci; Tinct. Opii Ammoniata; Tinct. Rhei.

No. 209. Iridis Rhizoma. *Orris Rhizome.*

(*Not official.*)

The dried and prepared rhizomes of several species of Iris, usually *Iris pallida*, *Iris Germanica*, and *Iris Florentina*.

Habitat.—Indigenous to Southern Europe and Western Asia, cultivated near Florence.

Characters.—The flattened rhizome is much branched, and occurs in pieces about four inches in length. The under surface is marked with numerous yellowish scars. As met with it is whitish externally, having been scraped to remove the dull external cortical layer. It breaks with an irregular fracture; odour resembling that of violets; taste aromatic and bitterish, afterwards producing an acrid sensation.

Composition.—Orris rhizome contains a small quantity of an essential oil, and myristic acid, commonly called orris camphor. Commercial oil of orris is prepared by macerating the rhizomes in cedar-wood oil, and then distilling it. Orris rhizome also contains an acrid resin and some starch. When the rhizome is exhausted with ether and the ether removed by evaporation, a minute quantity of

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a pale yellow essential oil is obtained ; but when the rhizome is steam distilled, a buttery-looking solid is obtained, consisting principally of myristicin, which is a product of decomposition through the action of steam ; this is sold as the essential oil.

Adulteration.—Occasionally the rhizomes of *Iris pseudo-acorus* and *I. fœtidissima* are substituted. Their rhizomes are darker in colour, and have an astringent and strong acrid taste.

SMILACEÆ.**No. 210. Sarsæ Radix. *Sarsaparilla* Root.**

The dried root of *Smilax officinalis*, and probably *S. medica* and *S. syphilitica*.

Habitat.—Indigenous to Central America and the northern part of South America.

Collection.—The roots are generally collected from plants of several years growth. The earth is first removed by scraping, and the roots dug up by means of a pointed stick. A portion of the root is always allowed to remain in the ground for further development. The earthy matter is removed, and they are then dried by the sun's heat, and finally made up into rolls.

Characters.—As met with in commerce, sarsaparilla root consists of a portion of the knotty rhizome, with the long trailing rootlets adherent to it. They are six feet or more in length, usually rolled into bundles about two feet long, and generally tied together with long roots of the same. The roots are cylindrical, somewhat furrowed, and tapering, their extremities covered with a blackish-brown or greyish cortical layer ; the roots vary in thickness, but rarely exceed that of a goose quill. A transverse section shows several zones, the central one forming the pith. Sarsaparilla is inodorous ; taste mucilaginous, slightly bitter, and acrid.

Composition.—Sarsaparilla contains parillin, resin, traces of a volatile oil, saponin, gum, and starch.

Smilacæ.

Parillin or Smilacin, $C_{14}H_{24}O_2$. This body is obtained by precipitating a strong alcoholic decoction with water, collecting the precipitate, washing it with ether, and purifying by re-solution in alcohol and adding charcoal. Flückiger obtained it in a crystalline form, and considers it closely related to saponin. When boiled with dilute sulphuric acid it yields parigenin and glucose, at the same time forming a green fluorescent solution. It gives similar reactions to saponin, and is insoluble in water.

Commercial Varieties of Sarsaparilla.—The sarsaparillas are usually divided into two groups, viz. : those in which the starch predominates, and those where it is only in comparatively small amount. The first are known as mealy or gouty, and the second as non-mealy or bearded.

Non-mealy Sarsaparillas.—These comprise the Mexican or Vera Cruz, Jamaica, Lima, and the Venezuelan or Caraccas.

The Mexican, Vera Cruz, or Tampico Sarsaparilla generally occurs in bundles about a yard in length, with few rootlets, having a deeply wrinkled pale brown cortex. This is probably obtained from *Smilax medica*.

Jamaica Sarsaparilla is the only one recognised by the British Pharmacopœia, and is commonly called bearded.

Lima Sarsaparilla resembles that of Jamaica, but is of a paler colour, and is usually packed in cylindrical bundles.

Caraccas Sarsaparilla closely resembles the Jamaica, but differs in being more mealy.

Mealy Sarsaparillas.—These comprise the Honduras, Rio Negro, Guatemala, and Guayaquil.

Honduras Sarsaparilla occurs in bales two or three feet in length. The roots are deeply grooved, the cortical zone being the thickest. They are usually covered with minute rootlets or “beard.”

Rio Negro Sarsaparilla is generally known as the Brazilian, Lisbon, or Para. It is seldom met with in the London market. It is devoid of any stem portion, and has but few rootlets.

Guatemala Sarsaparilla closely resembles the Honduras, but is generally of a lighter and brighter colour. It is

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probably derived from *Smilax papyraceæ*. It is rarely imported.

Guayaquil Sarsaparilla resembles Honduras, but is not packed in bundles, has the rootstock attached, and the rootlets are few and coarse.

Therapeutics.—Alterative.

Official Preparations.—Decoctum Sarsæ; Decoctum Sarsæ Co.; and Extractum Sarsæ Liquidum.

LILIACEÆ.**No. 211. Scilla. Squill.**

The bulb of *Urginea Scilla* (*Scilla maritima*), divested of its dry, membranous outer scales, cut into slices, and dried.

Habitat.—The squill is found growing on a silicious soil near the sea-shore of the basin of the Mediterranean.

Characters.—The squill bulb is pyriform and about six or eight inches in length, varying from one to four pounds in weight. After collection the bulbs are divested of the outer scales, stem, and rootlets, and are then cut transversely into thin slices, which are spread out and dried in the sun. The slices are in flattish pieces of a dull yellowish-white colour, sometimes tinged with a reddish hue; they are flexible, slightly translucent, and on drying become quite brittle and easily reduced to powder, which readily hardens into a mass because of its hygroscopic character. There are two varieties of the squill, white and red; the difference consisting merely in the colouring matter contained by the latter variety. The slicing of squills frequently gives rise to intense irritation of the skin; this is said to be occasioned by the minute acicular crystals of calcium oxalate.

Composition. Several principles have been isolated from squill, chief amongst them being scillain, a bitter principle, sugar, and gum.

Scillain or Scillitin. This glucoside was isolated by Jarmerstedt from the precipitate thrown down on addition of tannin to an infusion of squill. It is readily soluble in

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alcohol, and almost insoluble in water; strong sulphuric acid dissolves it, forming a brown solution with a green fluorescence, which, on addition of bromine, is changed to bluish-red. Dropped into boiling hydrochloric acid it colours it red, and slowly deposits a flocculent precipitate of a green colour; boiled with the dilute acid it yields glucose and another body soluble in ether. It is an amorphous white powder, which is strongly poisonous.

According to Merck, scillitin consists of three bodies, viz.: scillitoxin, scillipicrin, and scillin.

Scillitoxin is a cinnamon-brown substance readily soluble in alcohol, insoluble in water or ether. It has a bitter taste, and acts as a powerful irritant on the mucous membranes of the nose; strong sulphuric acid colours it red, then brown. Scillitoxin is a very strong poison, acting on the heart similarly to digitalin.

Scillipicrin is readily soluble in water, and the solution has a bitter taste. It is a yellowish-white amorphous powder, and very hygroscopic; it acts like scillitoxin on the heart, but in a less degree.

Scillin (Merck) is a light yellow, crystalline, tasteless powder. It separates from boiling alcohol or ether on cooling, and is almost insoluble in water. It is the least active of the three principles, producing numbness and vomiting.

The Gum is precipitated from an infusion on addition of basic lead acetate or alcohol, and the solution contains Sinistrin, $C_6H_{10}O_5$ (Schmiedeberg), which is precipitated by milk of lime.

Schroff states that squills contain a non-volatile acrid principle, Skulein (?).

Therapeutics.—Expectorant and diuretic.

Official Preparations—Acetum Scillæ; Oxymel Scillæ; Pilula Ipecacuanhæ cum Scillâ; Pilula Scillæ Co.; Syrupus Scillæ; Tinctura Scillæ.

No. 212. Aloe Barbadosis. *Barbadoes Aloes.*

The inspissated juice obtained from the leaves of Aloe vulgaris.

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Habitat.—Aloe vulgaris is indigenous to India and North-Eastern Africa; it has been introduced and is cultivated in the West Indian Islands.

Secretion.—The thick succulent leaves of this and other species of aloe are covered with a thick epidermis enclosing a mass of loose parenchymatous tissue. Between the mucilaginous pulp of the inside and the epidermis is a layer of thin tissue composed of numerous elongated, thin-walled ducts, containing a yellowish bitter juice, which on evaporating constitutes aloes.

Production.—The leaves are cut off at their base and immediately placed in a trough or suitable vessel with the cut end projecting downwards. The vessel is generally inclined so that the juice, which quickly flows from the cut ends, flows down and runs into another vessel placed to receive it, in which it is kept until required for evaporation.

The evaporation is usually carried out in copper vessels, considerable care being observed to remove any impurities. When the proper degree of viscosity has been reached, the juice is ladled out into gourds or boxes, in which it solidifies on cooling.

Characters.—Barbadoes Aloes, as imported in gourds or boxes, is sometimes quite soft, but is generally met with in hard brittle masses, varying from a deep reddish-brown or chocolate-brown to almost black. When broken the fractured surface is generally dull and waxy, with a strong disagreeable odour, which is increased by breathing on the surface; in mass it is opaque, but thin splinters are somewhat translucent and of an orange-brown hue. Taste nauseous and bitter; powder, dull olive yellow.

Curaçoa Aloes closely resembles the above, but differs in being more smooth and glossy, usually lighter in colour, and has a more conchoidal fracture.

Bonaire Aloes is indistinguishable from Curaçoa aloes; it is almost entirely soluble in alcohol or water, and yields to ether about 10 per cent. of its weight.

Composition.—Barbadoes aloes and its varieties contain an essential oil, a characteristic aloin, and resins.

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The Essential Oil, obtained by T. and H. Smith on distilling aloes with water, occurs in minute quantities, 500 pounds of aloes yielding only two fluid drachms (Craig). It is a pale yellowish mobile fluid, with a taste and smell slightly resembling those of peppermint.

Barbaloin, $C_{17}H_{20}O_7$?, can be obtained easily by the method devised by Tilden, which consists in dissolving the aloes in ten times its weight of boiling water previously acidulated with hydrochloric acid, and allowing the liquid to cool. It is then decanted, evaporated to about one quarter its bulk, and set aside to crystallise. The yield varies from 10 to 20 per cent. Barbaloin forms small prismatic needles, of a yellow colour, soluble in water and alcohol, the solutions yielding on addition of bromine water a precipitate of bromaloin, which crystallises in needles. It gives with a drop of nitric acid a crimson colour quickly fading; with nitric acid in excess it yields aloetic, chrysammic, picric, and oxalic acids.

Aloetic Acid, $C_{14}H_4(NO_2)_4O_2$, is an amorphous body of an orange-red colour, which, on further treatment with nitric acid, yields chrysammic acid.

Chrysammic Acid, $C_{14}H_4(NO_2)_4$, is soluble in potassium hydrate solution, from which it is precipitated by dilute acids in yellow crystals having a metallic lustre; reducing agents converting it into deep blue needles of hydrochrysamide.

The Resins were examined by Tilden, who obtained, by prolonged boiling, a portion soluble in water. They appear to be closely related to aloin, of which they are considered to be anhydrides.

Aloes distilled with lime yields a colourless oil, aloïsol (Robiquet), resembling amyl alcohol. The aloins obtained from Curaçoa and Bonaire aloes resemble barbaloin (Hanausek).

Therapeutics.—Purgative.

Official Preparations.—Aloin; Enema Aloes; Extractum Aloes Barbadosis; Pilula Aloes; Pil. Aloes et Ferri; Pil. Cambogiæ Co.; Pil. Colocynthis Co.; Pil. Colocynthis et Hyoscyami.

*Liliaceæ.***No. 213. Aloe Socotrina.** *Socotrine Aloes.*

The inspissated juice obtained from the leaves of Aloe Peryii and other species, of which A. Socotrina and A. Abyssinica are the most common.

Habitat.—The East Coast of Africa, Socotra, and Zanzibar.

Production.—Very little is known as to how this aloes is prepared. Dr. Balfour states that in the island of Socotra the natives dig a hole in the ground, into which they place the hide of an animal; the cut ends of the leaves are then arranged round the sides, and as they discharge their contents they are removed and replaced by fresh leaves. Having collected a sufficient quantity, the hide is skewered up and carried some distance, when the juice is generally allowed to evaporate spontaneously in vessels.

Characters.—Socotrine or Zanzibar aloes is generally met with in commerce in kegs or boxes, and frequently in skins. Occasionally it is imported in barrels, in a liquid condition, and separates on standing into two layers, the upper one transparent and of a deep rich brown colour, the bottom layer consisting of a bright yellow crystalline mass. In mass it is of a reddish-brown colour, which darkens on keeping; fracture resinous, sometimes irregularly conchoidal; in thin splinters it is translucent and of a ruby red colour. Odour strong but agreeable, slightly resembling saffron; taste bitter; powder tawny orange-brown. The masses are sometimes quite soft in the centre, opaque, and liver-coloured.

Socotrine aloes also is almost entirely soluble in alcohol or water, but only yields about 6 per cent. of its weight to ether.

Hepatic Aloes is the name applied to the more opaque and inferior masses of Socotrine aloes.

Moka Aloes is prepared in Arabia, and is generally in very dark masses, having an irregular fracture and somewhat disagreeable odour. It gives a red colour with nitric acid, like Barbadoes aloes. Does not occur in English commerce.

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Composition.—Socotrine aloes contains a peculiar aloin and resin, besides traces of an essential oil.

Socaloin, or Zanaloin, $C_{15}H_{16}O_7$?, is prepared by adding alcohol to the powder in sufficient quantity to make a paste, and then submitting to strong pressure, and crystallising the residual cake from warm weak alcohol (Histed). It crystallises in yellow needles, readily soluble in alcohol; it is but little affected on addition of a drop of strong nitric acid, but when treated with excess it yields aloetic, chrysammic, oxalic, and picric acids.

The resin is also separable into soluble and insoluble resin.

Commerce.—Socotrine or Zanzibar aloes is first shipped to Aden or Bombay, thence to this country.

Therapeutics.—Purgative.

Official Preparations.—Aloin; Decoctum Aloes Compositum; Enema Aloes; Extractum Aloes Socotrina; Ext. Colocynthis Co.; Pilula Aloes et Asafœtidæ; Pil. Aloes et Myrrhæ; Pil. Aloes Socotrinæ; Pil. Rhei Co.; Tinctura Aloes; Tinct. Benzoini Co.; Vinum Aloes.

No. 214. Aloe Natalensis. Natal Aloes.

(*Not official.*)

The inspissated juice of the leaves of an undetermined species of aloë.

Habitat.—The upper districts of Natal.

Production.—This kind of aloes is prepared in a similar manner to Cape aloes, only greater care is taken in the manufacture, the juice being constantly stirred while boiling until it acquires the proper consistency.

Composition.—Natal aloes contains a resin and a characteristic aloin.

Nataloin, $C_{16}H_{18}O_7$?, is prepared by triturating the aloes with an equal weight of alcohol warmed to 118° F., filtering, washing the crystalline mass with cold alcohol, and re-

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crystallising from boiling alcohol (Flückiger). It crystallises in pale yellow scales, which are readily soluble in methylic alcohol. Treated with strong nitric acid it yields picric and oxalic acids, but no chrysammic acid; a drop of nitric acid produces a more permanent crimson colour than barbaloin. When moistened with sulphuric acid, and then the vapour of nitric acid passed over the spot, the orange colour will change to green, then blue.

Comparative Test for the Aloins :—

			Nitric Acid.	Sulphuric and Nitric Acids.
Nataloin	...	...	Crimson	Green to Blue.
Barbaloin	...	...	Crimson	Nil.
Socaloin	...	...	Nil.	Nil.

All three aloins form bromo derivations, and are precipitated from their solutions by tannin. When distilled with zinc dust they yield methyl-anthracene.

No. 215. Aloe Capensis. Cape Aloes.

(*Not official.*)

The inspissated juice of the leaves of *Aloe ferox*, *A. spicata*, and *A. Africana*, and probably other species.

Habitat.—Indigenous to Southern Africa.

Production.—The juice is collected in a manner similar to that for Socotrine aloes, after which it is transferred to an iron pot, and evaporated down in a most careless manner, and then poured into boxes.

Characters.—Cape aloes is easily distinguished from the other varieties by its glossy appearance and dark brown colour, thin pieces being transparent. Odour strong, sour, and disagreeable; powder greenish-brown or yellow. As imported it frequently varies in brilliancy of fracture. It yields to ether nearly 6 per cent. of its weight.

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Composition.—Cape aloes is said to contain no aloin, but Kosmann isolated a crystalline principle having the formula $C_{31}H_{22}O_{20}$, the amorphous residue having the same composition. Treumann states that Cape aloes contains an aloin, $C_{46}H_{58}O_{20}$, $6H_2O$, but more recent investigations have failed to substantiate this.

Commerce.—Cape aloes is principally exported from Algoa Bay, Mossel Bay, and Cape Town.

No. 216. Resina Draconis. Dragon's Blood.

(*Not official.*)

A resinous exudation obtained by incising the stem of *Dracæna Cinnabari*, *Dracæna Draco*, and other species.

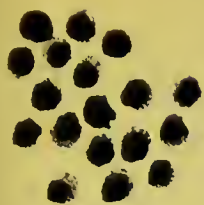
Habitat.—Indigenous to the Islands of Socotra, Teneriffe, and to the mountainous districts of Eastern Africa.

Characters.—This resin, which is seldom met with, is in roundish tears, or a coarsely granular powder of a deep red colour, melting at about 90° C.; emitting aromatic pungent fumes. It is soluble in ether or alcohol, forming a blood-red solution, insoluble in benzine or chloroform, but is readily dissolved by a solution of the alkaline hydrates.

Composition.—The resin has recently been examined by Dobbie and Henderson, who found it to consist of a resinous acid having the formula $C_{18}H_{18}O_4$, which gives a mauve-coloured precipitate with lead acetate. They also isolated a minute trace of cinnamic acid.

Other varieties of Dragon's Blood.

The bulk of the dragon's blood used in commerce is obtained from the fruits of *Calamus Draco*, Nat. Ord. *Palmæ*, indigenous to the East Indian islands. It is prepared by shaking the fruits in a bag, when the resin breaks off; it is then collected and made into cakes or sticks. An inferior quality is obtained by bruising the fruits and boiling them with water, skimming off the resin,



N^o 218.



N^o 217.



N^o 219.



N^o 220.



N^o 229.



N^o 221.



N^o 228.



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and rolling it into masses. It is a dark red-brown substance in rolls or cakes, somewhat porous, breaking with a resinous fracture. It melts at 80° C., giving off highly irritating fumes; it is soluble in ether, benzine, chloroform, and turpentine.

Composition.—It consists of an acid resin having the formula $C_{18}H_{18}O_4$ (Dobbie and Henderson), and yields benzoic acid. It yields on distillation, dracyl, C_7H_8 , and draconyl, C_8H_8 .

MELANTHACEÆ.**No. 217. Colchici Cormus. *Colchicum Corms.***

The fresh corms of *Colchicum autumnale* collected about the end of June or beginning of July.

Habitat.—Indigenous throughout Europe.

Collection.—The corms are dug up just as the foliage is decaying. They are then thinly sliced across and the sections dried by a gentle heat; the outer papery membranes are removed by winnowing or sifting.

According to Schroff and Maclagan the best time to collect the corms is during the period of flowering, or immediately afterwards.

Characters.—The fresh corms are about one inch and a half long and an inch broad, convex on one side, flattened and with a groove on the other; after removal of the brown membranous scales the exposed surface is an ashy-grey colour; internally solid and white. The dried slices are slightly reniform, surface white and starchy; breaking with a short fracture; taste sweet, acrid, and then bitter.

Composition.—The corms contain about 10 per cent. of starch, tannin, resin, sugar, and also colchicin, which is the active constituent of the drug. On drying they lose between 60 and 70 per cent. of moisture.

Therapeutics.—Sedative, Antirheumatic.

Official Preparations.—Extractum Colchici; Extractum Colchici Aceticum; Vinum Colchici.

*Melanthaceæ.***No. 218. Colchici Semina. *Colchicum Seeds.***

The seeds of *Colchicum autumnale*, collected when fully ripe, which is about the beginning of August, and carefully dried.

Characters.—*Colchicum* seeds are about one-twelfth of an inch in diameter, globular, slightly pointed at the hilum, the testa being of a dull reddish-brown colour and finely pitted. They are inodorous, and have a bitter, acrid taste; very hard, and with difficulty reduced to powder. Hertel and Morris have shown that unbroken seeds yield to solvents a greater proportion of the active constituents.

Composition.—*Colchicum* seeds contain colchicin, sugar, and a fatty oil.

Colchicin, $C_{22}H_{25}NO_6$, is obtained by Hertel's method. The seeds are exhausted with 85 per cent. alcohol, until a nearly colourless percolate passes. The liquid is agitated with calcined magnesia, and filtered after two or three hours, and then distilled in a vacuum pan until a liquid extract remains. To the extract ten times its volume of water is added, the oily matter separated, and then agitated with chloroform. The chloroform evaporated, when crude colchicin remains. Crude colchicin contains two resins, from which it can be freed by repeated treatment with chloroform. Colchicin is decomposed with dilute mineral acids, on boiling, into methyl alcohol and colchicein (Zeissel).

This substance has been shown to be methyl ether of an acid, and when heated for some time with strong hydrochloric acid it suffers demethylation, yielding the compounds colchicin, colchicein, and colchic acid, which bear the following relation.

Colchicin, $C_{22}H_{25}NO_6$.

Colchicein, $C_{21}H_{23}NO_6$.

Colchic Acid, $C_{16}H_{15}NO_5$.

Colchicein, $C_{21}H_{23}NO_6$, is in white crystals soluble in alcohol and hot water; on boiling with strong hydrochloric acid it yields apocolchicein and methyl alcohol.

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Colchicein gives a violet colour with strong nitric acid, which finally changes to green; strong sulphuric acid gives a bright yellow colour. Colchicein is precipitated from its solutions by most alkaloidal reagents. By warming with water colchicein is reconverted into colchicin.

The two resins are separable by treating with water, colchico-resin dissolves, and betacolchico-resin is insoluble.

The fatty oil is somewhat viscid and closely resembles castor oil.

Therapeutics.—Sedative and antirheumatic.

Official Preparation.—Tinctura Colchici Seminum.

No. 219. Sabadilla. Cevadilla.

The dried ripe seeds of *Schœnocaulon officinale* (*Asagraea officinalis*).

Habitat.—Indigenous to Eastern Mexico, also to Guatemala and Venezuela. The seeds are alone imported from Venezuela, and the fruits from Mexico.

Characters.—The fruit consists of three brown papery follicles half an inch long, each containing two seeds about one-third of an inch in length, narrow, flattened, and angular on one side, apex pointed; testa rugosely wrinkled, shining, and blackish-brown in colour. The seeds are inodorous, but have a bitter and acrid taste, and the powder is sternutatory.

Composition.—Cevadilla contains a fat, veratrine, veratric acid, and sabadillic acid.

The fat yielded to Pelletier and Caventou, on saponification and liberation of the acids, a volatile fatty acid sabadillic or cevadic, which resembles butyric acid in smell. It sublimes in pearly needles.

Veratric Acid, $C_8H_{10}O_4$, was obtained by Merck; it crystallises from alcohol in needles, which neutralise alkalies forming salts soluble in alcohol.

Veratrine, $C_{37}H_{53}NO_{11}$, as obtained from cevadilla, consists, according to Wright and Luff, of a mixture of

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three alkaloids, cevadine, veratrine, and cevadelline. It is obtained by concentrating a tincture of the seed and pouring it into water, filtering from precipitated resin, and adding hydrate of ammonium solution, collecting the precipitated veratrine, washing, and redissolving in dilute hydrochloric acid, purifying by filtration through animal charcoal, and again precipitating with ammonia, collecting and drying. As obtained by this process it is a pale buff amorphous powder, imparting to water an acrid taste. It neutralises acids, and when added to strong sulphuric acid and warmed, it forms a blood-red solution finally changing to violet (Henry). Strong hydrochloric acid dissolves it, and on warming forms a carmine red solution. When ignited it should leave no residue.

Cevadine is crystalline; it is the veratrine of Merck; it is the most abundant of the three alkaloids; it can be split up by saponification into cevadic acid and cevine; veratrine can be split up into veratric acid and verine; neither it nor sabadilline are crystalline, although the former yields some crystalline salts. The third alkaloid, cevadelline, is insoluble in ether, and on saponification yields cevilline and cevadic acid. Veratrine of commerce is a powerful poison, and causes intense sneezing when inhaled.

Therapeutics.—Used for neuralgia.

Official Preparation.—Veratrina.

No. 220. Veratri Viridis Rhizoma. *Green Hellebore Rhizome.*

The dried rhizome and rootlets of *Veratrum viride*.

Habitat.—Indigenous to the swampy districts of Canada and the United States.

Characters.—The rhizome is met with either entire or in transversely or longitudinally sliced pieces with or without the rootlets. The rhizome when entire is about two or three inches in length and nearly an inch in diameter; erect, obtuse, or truncate at the apex; dark brown exter-

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nally, white within. The upper end has frequently the remains of numerous leaves attached to it. The rootlets are of a yellowish-white colour, much shrivelled, and usually two or three inches long. It is inodorous, but has a bitter and acrid taste.

Composition.—The rhizome and rootlets contain several alkaloidal bodies, which were isolated by Wright and Luff, and included jervine, pseudo-jervine, rubi-jervine, veratrine, and cevadine.

Jervine, $C_{26}H_{37}NO_3 \cdot 2H_2O$, when pure, crystallises from alcohol, and is insoluble in water or ether. It is characterised by the insolubility of its sulphate, nitrate or hydrochlorate, being precipitated from solution on addition of these acids; the acetate and phosphate are soluble. Strong sulphuric acid dissolves it, forming a yellow fluid which changes to green.

Pseudo-jervine, $C_{29}H_{43}NO_7$, crystallises, and its sulphate is sparingly soluble in water. It gives the same colour reactions as jervine.

Rubi-jervine, $C_{26}H_{43}NO_2$, is a crystalline base soluble in ether; strong sulphuric acid dissolves it, forming a yellow solution which on addition of water changes through crimson, purple, violet, to indigo. Its sulphate is readily soluble in water.

Cevadine, $C_{32}H_{49}NO_9$, is a crystalline base, soluble in ether, and yields reactions similar to veratrine.

Jervic Acid, $C_{14}H_{10}O_{12}$, is a white crystalline acid powder, and is only sparingly soluble in cold water.

The rhizome is said to contain gallic acid.

Therapeutics.—Used to lower the heat in fevers, &c.

Official Preparation.—Tinctura Veratri Viridis.

No. 221. **Veratri Albi Rhizoma.** *White Veratrum Rhizome.*

(*Not official.*)

The dried and sliced rhizome with the rootlets of *Veratrum album*,

Araceæ.

Habitat.—The mountainous districts of Middle and Southern Europe, also some districts of the United States.

Characters.—The rhizome is erect, obconical, and of a dull earthy black colour, about three inches long, tufted above with the remains of leaves, the lower half marked with scars of old rootlets. Commercially the drug is met with having the rootlets removed and the rhizome cut off close to the summit, and is sometimes cut transversely. It has a sweetish, bitter, acrid taste, followed by a sensation of numbness; its powder is a powerful sternutatory.

Composition.—This drug is similar in composition to Green Hellebore, but contains in addition the alkaloid veratralbine.

Veratralbine or Veratroidine, $C_{28}H_{43}NO_5$, is a white amorphous bitter principle, and is non-sternutatory. When dissolved in strong sulphuric acid it gives a play of colours finally becoming blood-red, with a green fluorescence.

Veratramarin is a light yellow bitter colouring principle easily soluble in water and alcohol, from which it is precipitated with lead acetate.

Comparative value of Veratrum Album and V. Viride.—The following table is from the researches of Wright and Luff, and gives the proportion of the alkaloids per kilo :—

	V. Album.	V. Viride.
Jervine . . .	1·3 grm.	·2 grm.
Pseudo-jervine . .	·4 „	·15 „
Rubi-jervine . . .	·25 „	·02 „
Veratralbine . . .	2·2 „	Traces.
Veratrine . . .	·05 „	Less than ·004 „
Cevadine . . .	Nil.	·43 „

ARACEÆ.

No. 222. Calami Aromatici Rhizoma. *Sweet Flag Rhizome.*

(*Not official.*)

The rhizome of *Acorus Calamus* freed from its rootlets.

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Habitat.—The plant grows wild throughout Europe, Central Asia, and North America.

Characters.—Sweet flag rhizome is met with in pieces from several inches to a foot or more in length, marked with numerous annulations on its upper surface, and circular root-scars on its lower surface. It is reddish-brown in colour externally, and of a pale pinkish hue internally. It presents a rough and wrinkled appearance, and breaks with a short, corky fracture. Texture spongy; odour agreeably aromatic; taste aromatic and bitter.

Composition.—The rhizome contains an essential oil, a bitter principle, resin, gum, and starch.

The Essential Oil is obtained by steam distillation, the dried rhizome yielding in some instances as much as 2 per cent. It is of a pale yellow colour when fresh, but becomes dark brown on keeping. When fractionated it yields a hydrocarbon, $C_{10}H_{16}$, the higher fraction of which has a deep blue colour, and is not of a constant boiling point (Kurbatow).

Acorin.—The bitter principle is obtained by precipitating a decoction with basic lead acetate, filtering and removing lead from the filtrate with sulphydric acid, decanting the clear solution, neutralizing with bicarbonate of sodium, and then agitating with ether. The ethereal layer, on evaporation, leaves an amorphous residue of crude acorin (Faust). According to Flückiger it is precipitated from its solution by tannin, and may be obtained by triturating the precipitate with lead oxide, and afterwards with chloroform. The chloroformic solution deposits crystals of acorin.

Commerce.—Sweet Flag is imported from Northern Germany and Southern Russia; little if any is now collected in England.

GRAMINACEÆ.**No. 223. Saccharum Purificatum. Refined Sugar.**

Synonyms:—*Sucrose, Saccharose.*

The refined sugar of *Saccharum officinarum*.

Graminaceæ.

Habitat.—The sugar cane is probably a native of India, but is not now found in the wild form. It is cultivated more or less in tropical and sub-tropical countries, particularly in South America, India, and Mexico. Several varieties are known, differing chiefly in colour and hairiness of the stems.

Manufacture.—The sugar canes are heated in a current of steam and then submitted to pressure in a rolling mill, when the juice is obtained; this flows through a metallic sieve into a copper boiler known as the clarifier. The juice is heated in the cauldron, and when the temperature reaches 130° F., a certain amount of milk of lime is added, which causes a thick scum to rise to the surface when the juice is boiling. The juice is then strained into a second pan and again boiled, and a second scum removed; it is run into others of smaller dimensions, and evaporated to the point of crystallisation. The evaporation is chiefly carried out now by means of pipes heated with steam, and the sugar so obtained is known as raw or muscovado sugar; the dark mother liquor constitutes the molasses or treacle, from which a large quantity of sugar is obtained by means of strontium hydroxide.

Refining or Purification.—The raw sugar is dissolved in water, heated with steam pipes, and the impurities removed by an addition of milk of lime, albuminous substances, or animal charcoal. The clarified solution is then filtered through bags, and afterwards through animal charcoal filters to remove colouring matter, from whence it passes into the vacuum pans. The evaporation in the vacuum pans is carried on until it becomes somewhat granular, after which it is run into moulds, one end of which is perforated to allow the syrup to drain away. When crystals are to be prepared, the solution is run into the sieve of a centrifugal machine and the syrup removed by this means.

Characters.—Cane sugar is sold in compact crystalline masses, known as loaf sugar. It dissolves readily in cold water and in almost all proportions in boiling water, forming a clear bright sirupy liquid; it dissolves sparingly in alcohol, but more freely when warmed. Its aqueous solution

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deviates a ray of polarized light to the right; it forms a compound of feeble affinity with chloride of sodium and the hydrates of the alkaline earth metals.

Composition.—Cane sugar, when pure, is a carbo-hydrate, having the composition $C_{12}H_{22}O_{11}$; it melts at 320° F., and if kept melted, becomes changed into glucose and levulosan; at a higher temperature it is decomposed, yielding caramel. When treated with dilute acids, or under the influence of ferments, it is converted into dextrose and levulose. Nitric acid transforms it into oxalic, saccharic, and racemic acids; its solution does not reduce Fehling's solution. Strong sulphuric acid readily decomposes it, depositing a large amount of carbon, and evolving sulphurous anhydride; solution of potassium hydrate should not turn brown on addition of cane sugar.

Other Sugars.—Beet Sugar, or Betose, obtained from the juice of *Beta vulgaris*, Nat. Ord. *Chenopodiaceæ*. This is cane sugar, and is obtained by a similar process to that employed for the sugar cane, only the crude molasses from this source of sugar is destructively distilled, whereby a considerable amount of methyl-alcohol and other products are obtained, the ash being principally potash salts.

Cane sugar is also found in the maple and several graminaceous plants.

Grape Sugar, or Glucose, is contained in grapes, but this sugar is artificially prepared from oats by hydrolising the starch by means of dilute sulphuric acid. It is manufactured on a large scale in America. It is distinguished from cane sugar by its feebler sweetening properties, its powerful reducing action on Fehling's solution, and by turning a solution of potash brown.

Official Preparation.—Syrupus.

No. 224. *Hordeum Decorticatum.* Pearl Barley.

The dried seed, divested of its integuments, of *Hordeum distichum*.

Habitat.—Indigenous to Western Asia. Cultivated throughout Europe and America.

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Preparation.—The fruit is carefully ground or reduced in size by passing between horizontal mill-stones until it becomes nearly rounded and free from the whole of the integuments.

Characters.—Pearl barley is white, rounded, or elliptical in shape, with a trace of the longitudinal furrow to which are attached fragments of the integuments. It is inodorous; the taste is farinaceous and insipid.

Composition.—Pearl barley contains nearly 70 per cent. of starch, and about 15 per cent. of proteids, with a small quantity of an oil consisting of the glycerides of lauric and palmitic acids; and about 6 per cent. of dextrin. On incineration the ash amounts to nearly 3 per cent.

Official Preparation.—Decoctum Hordei.

No. 225. Amylum. Starch.

The starch procured from the grains of the common wheat, *Triticum sativum*; maize, *Zea Mays*; and rice, *Oryza sativa*.

Habitat.—Wheat and maize are cultivated in tropical and subtropical countries. Rice is a native of India, and is cultivated in tropical countries.

Preparation.—The grain is first soaked in water to which a little caustic soda has been added, and when soft it is crushed between rollers and coarsely ground, after which it is placed in vats, when fermentation takes place. Several acids are thus formed, and the gluten loses its tenacity. The mass is then poured into a perforated cylinder, which is rotated, the milky liquid which passes through is allowed to settle in a vat, and the starch washed several times by decantation. It is then dried in a warm room and reduced to fine powder by grinding.

Characters.—Starch is a white inodorous powder in angular or columnar masses; it is slippery when rubbed between the fingers, and emits a peculiar crackling noise; it is devoid of taste, and when triturated with water and then

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boiled it forms a gelatinous mass, which on cooling gives a deep blue colour with iodine. Examined under the microscope the official varieties present the following characters:

Wheat Starch.—A mixture of large and small granules, lenticular in form, and marked with faint concentric striæ, surrounding a nearly central hilum.

Maize Starch.—Granules uniform in size, frequently polygonal, rounded on the edges, about two-thirds the size of wheat starch, hilum distinct and slit, striæ indistinct.

Rice Starch.—Granules extremely minute, uniform in size, polygonal, hilum small and without striæ, usually aggregated with larger grains.

Composition.—Starch granules consist of two distinct carbo-hydrates having the formula $C_{18}H_{30}O_{15}$, the outer film is called cellulose or amylin, and the inner portion granulose, farinose, or amidin. The former gives a brown and the latter a deep blue colour with iodine; when heated at high temperatures it changes colour and is converted into dextrine. Strong nitric acid dissolves it, and the solution on addition of water precipitates xyloidin.

Other Starches.—Several other starches are met with in commerce under different names. Arrowroot is the starch prepared from the rhizomes of *Maranta arundinacea*, Nat. Ord. *Marantaceæ*.

Tous-les-mois, or Canna Starch, is obtained from the rhizome of *Canna edulis*, Nat. Ord. *Marantaceæ*.

Brazilian Arrowroot or Tapioca is prepared from the root of *Manihot Utilissima*, Nat. Ord. *Euphorbiaceæ*.

Sago is the prepared pith of *Metroxylon Sagu*, Nat. Ord. *Palmaceæ*.

Potato Starch is obtained from the tubers of *Solanum tuberosum*, Nat. Ord. *Solanaceæ*.

Official Preparations. — Glycerinum Amyli; Mucilago Amyli; Pulvis Tragacanthæ Co.; Suppositoria Acidi Tannici cum Sapone; Sup. Morphinæ cum Sapone.

*Graminaceæ.***No. 226. Graminis Rhizoma. Couch Grass.**

(*Not official.*)

The rhizome of *Triticum repens* (*Agropyrum Repens*) deprived of its rootlets.

Habitat.—Indigenous to Europe.

Characters.—Couch Grass, or Quitch, as met with in commerce, is cut into small sections, pale yellow in colour, hollow in the centre, smooth, inodorous, but having a faint sweetish taste.

Composition.—Couch Grass contains a minute quantity of sugar, and a peculiar principle, triticin.

Triticin, $C_{12}H_{22}O_{11}$, is obtained from a decolorised decoction by concentration and precipitation by means of alcohol. It is an amorphous powder somewhat resembling inulin; its solution readily reduces Fehling's solution. It is easily converted into glucose by boiling with dilute acids, or by keeping its solution for some time at $110^{\circ} C$.

The rhizome leaves about 4 per cent. of ash on incineration.

No. 227. Farina Tritici. Wheaten Flour.

The grain of *Triticum sativum* ground and sifted.

Habitat.—Cultivated in this country, probably indigenous to Central Asia.

Characters.—Wheaten flour is a fine, nearly white powder, somewhat gritty to the touch, with a distinct farinaceous odour and taste.

Composition.—It consists principally of starch with varying proportions of gluten.

Gluten is best prepared by kneading the flour in a linen bag under water until the liquid is nearly colourless, when it is left as a strongly adhesive mass. It is purified by dissolving it in dilute potash solution, filtering and pre-

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precipitating with acetic acid. The precipitate is repeatedly treated with alcohol and then washed with ether, the residue being gluten-casein.

Gluten-fibrin is obtained by evaporating the alcoholic washings; this latter also contains minute quantities of gliadin and mucedin.

Official Preparation.—Cataplasma Fermenti.

Sub-Class ACOTYLEDONS.**FILICES.****No. 228. Filix Mas. Male Fern.**

The rhizome with the persistent bases of the petioles of *Aspidium Filix-mas*.

Habitat.—The male fern is indigenous all over Europe and in certain districts of the United States.

Characters.—The rhizome or caudex is from three to six inches in length, and about one inch in diameter. When fresh it is green and fleshy, but on drying it becomes hard and of a reddish-brown hue externally, and covered with the hard persistent curved bases of leaf stalks, which are of a dark colour. A transverse section is of a light brown colour, and shows generally eight fibro-vascular bundles. Odour disagreeable; taste astringent and sweetish, subsequently nauseous. It should be collected late in the autumn and divested of scales, roots, and all dead portions, and carefully dried by a gentle heat. It should not be used if more than a year old.

Composition.—Male fern rhizome contains a fatty oil, resin, tannic acid, gum, and starch.

The Fatty Oil. The green portion which separates from an ethereal extract consists, according to Luck, of the glycerides of filosmylic and filixolic acids, which are obtained by decomposing the sodium soap; the filosmylic acid is volatile.

Filicic Acid was obtained by Perchier as a granular deposit from the ethereal extract. It yields phloroglucine

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and butyric acid on fusion with caustic potash. It is regarded as the active constituent of the rhizome.

The Tannic Acid was examined by Malin, and was decomposed by boiling with dilute acid into filix-red and sugar. This tannin was formerly regarded as composed of two acids, namely, tanaspidic and pteritannic acids.

Therapeutics.—Anthelmintic.

Official Preparation.—Extractum Filicis Liquidum.

FUNGI.**Sub-Order ASCOMYCETES.****No. 229. Ergota. *Ergot.***

The sclerotium of *Claviceps purpurea* produced between the pales and replacing the grain of *Secale cereale*.

Habitat.—It is collected chiefly in Spain and Southern Russia.

Development.—The development of this fungus takes place in three distinct stages. At the flowering season one or more of the ovaries becomes enveloped in a thick yellowish sweet coating called the “honey-dew of rye.” This honey-dew contains a large quantity of sugar which quickly reduces Fehling’s solution; it consists of numerous minute cells or conidia; these are formed by the growing mycelium of the young fungus. This mycelium is composed of numerous filamentous cells or hyphæ, with an outer layer of diverging cells or basidia, which form the hymenium by which it is separated from the conidia. In this condition the ergot is known as the sphacelium or primary stage. The hyphæ of the sphacelium now unite into a compact body at the base of the ovary, which grows rapidly towards its apex, forming a purplish-black body, which, when full grown, is called the sclerotium. By such a method of growth the caryopsis of the rye becomes completely destroyed, and is not merely transformed into the fungus. The ergot, if kept for several months, will complete its final stage by developing the mature fungus,

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which resembles a mushroom in miniature, but contains cavities called perithecia. These contain numerous spore sacs or asci, which are discharged from the conceptaculum about the time the rye is in flower.

Characters.—Ergot is a sub-cylindrical or fusiform body, about one inch in length, generally curved and tapering towards the ends. Externally it is a purplish-black colour, internally whitish, frequently fissured and longitudinally furrowed. Odour disagreeable and heavy, particularly if moistened with solution of potash; taste oily, mawkish, rancid, and unpleasant. It is best preserved kept quite dry in bottles and sprinkled with chloroform.

Composition.—Ergot contains a multiplicity of uncrystallisable principles, which, according to Buchheim, is due to the low organisation of the fungus. Besides these principles it contains a fatty oil, resin, and ergosterin.

The Fatty Oil is contained in ergot to the extent of 30 per cent. It is of a brownish-yellow colour, and a slight aromatic flavour and acrid taste. It consists principally of palmitin and olein. On agitation with alcohol, the alcoholic layer on evaporation leaves cholesterin and resin. It is also said to contain lactic acid.

Ergotinine ($C_{35}H_{40}N_4O_6$). Process: the oily extract is agitated with ether, and the ethereal solution agitated with dilute sulphuric acid, which removes the alkaloid. This solution is rendered alkaline and shaken with chloroform. The ergotinine is obtained on evaporating the chloroformic solution. It was isolated by Tanret.

Ecboline was obtained by Ganser to the extent of .16 per cent. It is separated from ergotinine by precipitation with mercuric chloride. Dragendorff regards it as a modification of ergotinine.

Sclerotic Acid is obtained by digesting ergot, previously exhausted with ether and alcohol, with water, dialysing the solution, concentrating the dialysate, and precipitating with an excess of strong alcohol. The precipitate is digested with weak alcohol and hydrochloric acid, when the sclerotic acid is precipitated on addition of strong alcohol. Sclerotic

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acid is an inodorous, tasteless substance, and is said to possess the active properties of ergot.

Scleromucin is precipitated on addition of alcohol to the dark fluid contained in the dialyser. Neither of these two bodies are glucosides, but they are precipitated from their solution by tannic acid.

Sclererythrin, scleriodin, Tuscosclerotinic acid, Picrosclerotin, scleroxanthin, and sclerocrystallin are found in minute quantities. The two former are colouring principles of ergot.

Ergosterne, $C_{26}H_{40}O$, H_2O , is a monatomic alcohol closely allied to cholesterin. It is soluble in alcohol and ether; it is distinguished from cholesterin by its solubility in strong sulphuric acid, and this solution is not coloured on agitation with chloroform.

Test for Ergotised Flour.—Macerate the flour in twice its volume of ether for twenty-four hours, with a few drops of dilute sulphuric acid, filter, and agitate the filtrate with a solution of sodium bicarbonate, when a reddish-violet colour will be produced if ergot be present (Hofmann).

Therapeutics.—Uterine stimulant.

Official Preparations.—Extractum Ergotæ Liquidum; Infusum Ergotæ; Tinctura Ergotæ.

No. 230. Cerevisiæ Fermentum. Beer Yeast.

The ferment obtained in brewing beer, and produced by *Saccharomyces cerevisiæ*.

Characters.—Yeast consists of numerous round or elliptical cells, varying in size, and as obtained during fermentation of beer, it is viscid, semi-fluid, and frothy, and has a peculiar odour and bitter taste.

There are two varieties of yeast, known in commerce as top and bottom yeast; the former is the one principally obtained in this country.

Composition.—Yeast is said by some to contain a peculiar principle called invertin, which was isolated by Barth, by

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digesting dried yeast in water, and then pouring the filtrate into a large excess of alcohol, when it is precipitated. When dried it constitutes a brown amorphous mass.

Official Preparation.—Cataplasma Fermenti.

LICHENES.**No. 231. Cetraria. Iceland Moss.**

The dried lichen, *Cetraria Islandica*.

Habitat.—Indigenous to northern latitudes.

Characters.—The plant is foliaceous, erect, irregularly branched in a dichotomous manner into fringed, obtuse, flattened lobes; crisp, smooth, and generally of a brownish or greyish-white colour on the upper surface; lower surface whitish, with numerous depressed spots. It is almost odourless when dry; when moistened it becomes cartilaginous and leathery, has a slight odour and a bitter mucilaginous taste.

Composition.—It contains about 70 per cent. of lichenin starch, $C_{12}H_{20}O_{10}$, which is freely soluble in Schieber's solution. Small quantities of cetraric acid, a bitter principle, are present, with varying proportions of lichen-stearic, oxalic and fumaric acids, and thallo-chlor, a peculiar chlorophyll.

Therapeutics.—Demulcent.

Official Preparation.—Decoctum Cetrariæ.

No. 232. Lacmus. Litmus.

A blue pigment obtained from *Roccella tinctoria*, *R. fuciformis*, and other species.

Preparation.—The lichen is reduced to powder and then mixed with caustic potash and urine, or any ammoniacal fluid, and exposed to the air for some time. The solution passes through several shades of colour, but finally acquires a blue colour; it is now mixed with chalk and made into a paste and cut into small square blocks.

Algæ.

Characters.—Litmus is generally sold in small friable cakes of a deep blue colour, which effervesce strongly on the addition of an acid. It has a saline and pungent taste; the aqueous infusion is turned red by acids.

Composition.—According to Kane it contains erythro-litmin, erythrolein, azolitmin, and spaniolitmin. The first two are soluble in strong alcohol, and the latter two insoluble, but soluble in weak alcohol or water.

ALGÆ.**No. 233. Chondrus.** *Irish or Carrageen Moss.*

(*Not official.*)

The dried entire plant of *Chondrus crispus*.

Habitat.—Indigenous to Northern Europe.

Characters.—Carrageen in the fresh condition is soft and cartilaginous, and is of a purplish colour, which becomes lighter on washing; when dried it shrinks into a horny translucent membrane. The thallus is from 3 to 6 inches long, with a slightly cylindrical stem expanding like a fan; it has a seaweed-like odour and saline taste.

Composition.—It consists principally of mucilage, which yields mucic acid on treatment with nitric acid. This mucilage contains 21 per cent. of nitrogen (Blondeau); when boiled with dilute sulphuric acid it yields aldehyd fucusol.

A D D E N D A .

THALAMIFLORÆ.

RANUNCULACEÆ.

Pulsatilla. Pulsatilla.

The flowering herb of *Anemone Pulsatilla* and other species.

Habitat.—Indigenous to Europe and America.

Character.—The root is a dark brown colour, from which the flowering stem arises, bearing erect flowers with spreading sepals of a purplish colour, which appear before the leaves. The leaves are rounded in outline and much divided, and deep green in colour, shiny on the upper surface.

Composition.—The plant contains a peculiar body, anemonol. When the bruised plant is submitted to distillation with water, and the distillate, after cooling, agitated repeatedly with ether, and the separated ethereal portions allowed to spontaneously evaporate, a pale yellow very acrid oil remains, which is anemonol. This body is soluble in glacial acetic acid, and very readily decomposes into anemonin, $C_{15}H_{12}O_6$, and anemonic acid, $C_{15}H_{14}O_7$. Anemonin may be separated from anemonic acid by treating the mass with boiling alcohol, which removes the former. Anemonic acid is crystalline, white, and soluble in caustic potash, forming a yellow solution.

Papaveraceæ.

BERBERIDACEÆ.

Berberis Cortex. Barberry Bark.

The dried bark of the root of *Berberis vulgaris*.

Habitat.—Indigenous to Europe.

Character.—The bark is found in thin irregular pieces of a light greyish colour externally, the inner surface being bright orange yellow, and very smooth; it is odourless, but has a marked bitter taste, at the same time tinging the saliva a light yellow colour.

Composition.—It contains oxyacanthine, berberine, and a peculiar variety of tannin.

Berberine, $C_{20}H_{17}NO_4$. This alkaloid is found in several other plants. To prepare it the bark is thoroughly exhausted with boiling water, and the decoction evaporated to an extractiform consistency, and then digested in strong alcohol (92 per cent.) and filtered, the spirit recovered and the residue acidulated with sulphuric acid and allowed to stand, when berberine sulphate crystallises out. When berberine is dissolved in hydrochloric acid and chlorine added a blood red colour is produced. It may be estimated in aqueous solutions by means of Mayer's reagent 1 cc = .0425 grm., and the precipitate contains half its weight of berberine.

Oxyacanthine, $C_{32}H_{46}N_2O_{11}$, can be precipitated from the mother liquor after the crystallisation of the berberine by the addition of ammonia. It gives a yellow colour with nitric acid, changing on warming to purple, and its solution quickly reduces iodic acid.

The tannic acid strikes a dark green with a ferric salt.

PAPAVERACEÆ.

Sanguinaria. Bloodroot.

The dried rhizome of *Sanguinaria canadensis*.

Habitat.—Indigenous to Canada and the Northern States of America.

Bixaceæ.

Characters.—The rhizome varies from three to four inches long and about half an inch thick, cylindrical, branching occasionally, and its upper surface marked with the annulations of the leaves; externally it is of a light brown colour, red internally; odour heavy, and taste bitter and acrid.

Composition.—It contains sanguinarine, porphyroxine, resin, citric and malic acids.

Sanguinarine, $C_{19}H_{17}NO_4$, is obtained by making an alcoholic extract, dissolving it in dilute hydrochloric acid, filtering from separated resin, and adding to the filtrate solution of ammonia, then removing the alkaloid by means of ether: it is purified by repeating the treatment. It forms bright red salts with acids.

Porphyroxine remains in the ammoniacal liquor, and is obtained by neutralising the solution and precipitating with tannin, the tannate is decomposed with litharge and the alkaloid removed with ether.

The resin, which is of a red colour, consists of two resins, which yield, when fused with caustic soda, proto-catechuic acid.

BIXACEÆ.**Arnotta. *Annotta.***

A colouring substance prepared from the seeds of *Bixa Orellana*.

Habitat.—Tropical America.

Characters.—The seeds are contained in round capsules, and are quite white, but covered with a dark red pulpy mass. *Annotta* is met with in cakes of a deep red colour, the cakes are soft when recently prepared, and possess a strong peculiar odour and bitter taste. It is only sparingly soluble in water, but readily in oils, alcohol, and alkaline solutions, forming a dark red liquid.

Preparation.—The seeds are usually allowed to ferment for some time, or thoroughly soaked in water, then crushed,

Malvaceæ.

and finally mashed, and again washed with water. After the washing the colouring matter subsides, and is then moulded into cakes or rolls.

Composition.—Annotta contains two colouring bodies, orellin and bixin, also a fatty acid and hydrocarbon.

Bixin is the red colouring constituent, which is insoluble in water, sparingly in alcohol, and readily in alkalies.

Orellin is a light yellow substance, which can be removed by repeated treatment with water.

Adulterations.—Annotta is frequently weighted with substances like gypsum, sand, and ochre, but these are readily detected by the residue left on treatment with boiling alcohol.

Uses.—Annotta is extensively used for colouring butter and cheese, and also as a dye for silk, &c.

MALVACEÆ.**Althææ Radix.** *Marshmallow Root.*

The dried and prepared root of *Althææ officinalis*.

Habitat.—Indigenous.

Characters.—The roots are generally collected from plants three or four years old, and the succulent branches separated and the woody root-stock rejected. It occurs in tapering pieces four to ten inches long, of a whitish colour externally, the yellow cortical layer being removed; fracture granular, odour faintly aromatic, taste sweet and gummy.

Composition.—The prepared root contains a large quantity of mucilage and starch, also asparagin, oil, and sugar. Asparagin is best prepared by dialysing an infusion and concentrating, when it crystallises out. This body is amido-succimanic acid, $C_4H_8N_2O_3H_2O$.

Substitute.—Considerable quantities of Hollyhock, *Althæa Rosea*, rootlets are prepared similar to Marshmallow.

Leguminosæ.

STERCULIACEÆ.

Colæ Semen. *Cola Nut.*

The dried seeds of *Sterculia Acuminata*.

Habitat.—Indigenous to tropical Africa.

Characters.—The seeds are from two to four inches long, and when fresh are of a bright red colour, changing on drying to a dark reddish-brown, mottled, flattish, and ovate in form, odour pleasant, and taste faintly aromatic, but distinctly bitter when fresh. The seeds are now imported in considerable quantities from West Africa, and are used in the manufacture of chocolate.

Composition.—They contain large quantities of starch, sugar, and gum, in smaller quantities caffeine, fatty and volatile oils, and tannin. The amount of caffeine varies, but 2 per cent. was found as the mean of four estimations.

CALYCIFLORÆ.

LEGUMINOSÆ.

Tonka Faba. *Tonquin Bean.*

The dried seeds of *Dipteryx Odorata*.

Habitat.—Indigenous to Brazil and Guiana, where the trees grow to a height of 80 feet.

Characters.—The seeds are from one to two inches long, much wrinkled and two edged. The testa is black, with a dull lustre, and frequently covered with minute crystals of coumarin; internally they are a light brownish-yellow in colour, and are easily separated into the two cotyledons; odour strongly aromatic; taste slightly bitter. The fruit resembles that of the almond tree.

Composition.—The principal constituent is the odorous principle coumarin; it also contains a fatty oil and a large quantity of proteids.

Leguminosæ.

Coumarin, $C_9H_6O_2$, is the ethereal anhydride of coumaric acid. It is extracted by exhausting the beans with alcohol, then distilling off the greater portion of the solvent and adding water, when it crystallises out on cooling. It can also be prepared from salicylic aldehyde by the addition of sodium, and then treating the resulting compound with anhydrous acetic acid. It melts at $67^\circ C.$ and boils at $290^\circ C.$, and when boiled with caustic soda it is converted into coumaric acid. Coumarin is also found in *Asperula odorata*, *Melilotus officinalis*, and *Anthoxanthum odoratum*.

Arachis Oleum. *Ground Nut Oil.*

The oil obtained by crushing the seeds of *Arachis hypogæa*.

Habitat.—Indigenous to tropical Africa, cultivated in Brazil and Australia.

Characters.—Fruit. After the fertilisation of the ovary it is gradually extended on a stalk (carpophore), reaching a length of three inches, curving downwards during its growth, the ovary enlarges at the same time, and becomes buried in the ground, when it ripens into a wrinkled pod containing the seed. The seeds are about the size of a pea, and are largely eaten as a food ; they are very nutritious and oily.

The Oil. This is a pale yellow, thin, oily liquid, specific gravity varying from .918 to .920 ; it becomes turbid at $37.4^\circ F.$, and congeals to a solid at $23^\circ F.$ It is a non-drying oil, with an agreeable odour and a peculiar nutty flavour.

Composition.—The seeds yield by expression about 45 per cent. of this oil, the marc retaining about 6 per cent. The oil consists of a mixture of the glycerides of arachic, palmitic, and oleic acids. The acids may be separated after saponification by fractional crystallisation from alcohol. Under the name of Katching oil it is largely used for cooking purposes ; it is also used in the manufacture of margarine.

Rosaceæ and Pangiaceæ.

Allied Oils.—Benne, or Sesame Oil, expressed from the seeds of *Sesamum indicum*, which yield 50 per cent.

Soy Oil, expressed from the seeds of *Soja hispida*, which yield 17 per cent., the marc being used for preparing Soy.

Ben, or Behen Oil, expressed from the seeds of *Moringa pterygosperma*, which yield 25 to 30 per cent.

ROSACEÆ.**Quilliaiaæ Cortex.** *Soap Bark.*

The prepared and dried inner bark of *Quilliaia Saponaria*.

Habitat.—Indigenous to Chili and Peru.

Characters.—As met with in commerce the brown suberous layer is removed, and it occurs in long flat pieces with an occasional patch of the corky layer adherent; externally it is a light reddish-yellow, and internally of a light yellow colour, fracture splintery, and the dust has a powerful sternutatory effect; taste acrid, and its aqueous infusion froths copiously on agitation.

Composition.—The bark contains saponin, calcium sulphate, and starch.

Saponin, $C_{56}H_{86}O_{26}$ (?), can be isolated by the same process as Senagin, the bark yielding nearly 10 per cent.; it is a white amorphous powder, readily soluble in water, and yields sapogenin and glucose on hydrolysis.

Use.—A decoction is largely used as an emulsifying agent, and in place of soap for cleaning delicate fabrics, such as fine lace, &c.

PANGIACEÆ.**Gynocardiaæ Semen.** *Chaulmugra Seeds.*

The seeds from the ripe fruit of *Gynocarda odorata*.

Habitat.—Indigenous to Eastern India and the Malayan Peninsula, where it flourishes as a large tree.

Hamamelaceæ and Umbellifera.

Characters.—The seeds are ovoid, irregular, from one to one and a half inch long, flattened from mutual pressure, testa brittle and dull grey in colour, internally white and oily, with a peculiar odour and disagreeable taste.

Composition.—The seeds contain a considerable quantity of a peculiar fatty oil, to which they owe their value.

The oil is obtained by expression between hot plates, or by boiling the seeds with water; it is a buttery looking body, melting at 104° F., and has a distinct acid reaction which is due to free palmitic and gynocardic acids. The oil yields 81 per cent. of fatty acids on saponification, consisting of the following:—

Gynocardic Acid	...	11·7	per cent.	
Palmitic	„	...	63·	„
Hypogæic	„	...	4·	„
Cocinic	„	...	3·3	„ (Moss.)

The oil is largely used in cutaneous diseases.

HAMAMELACEÆ.**Hamamelis Folia.** *Witchhazel Leaves.*

The dried leaves of *Hamamelis Virginica*.

Habitat.—Canada and the United States.

Characters.—The leaves vary from four to six inches in length, obovate oval, with short petioles, pubescent, smooth, inodorous, taste astringent.

Composition.—The leaves contain a small quantity of a volatile oil, tannin, and a bitter principle, but no correct analysis is on record.

UMBELLIFERÆ.**Apii Fructus.** *Celery Seed.*

The dried fruit of *Apium Graveolens*.

Habitat.—Indigenous to Europe.

Umbelliferae.

Characters.—The fruits are rounded, but flattened laterally, brown, ribs lighter coloured, smooth, usually separated into the two mericarps; odour and taste aromatic.

Composition.—The fruits yield about 2 per cent. of a volatile oil on distillation; they also contain a considerable quantity of a fatty oil, apiol, and apiin.

Apiol can be obtained by exhausting the fruits with petroleum ether, then evaporating the solvent and exhausting the residue with 95 per cent. of alcohol; this, on evaporation, leaves the apiol. It is an oily body with a strong odour, and is partly emulsified with alkalies. Apiin crystallises in shining needles from cold alcohol, and with ferrous sulphate it gives a blood-red colour.

Allied Plant.—Parsley, *Petroselinum sativum*, contains also apiol and apiin.

Carotæ Fructus. *Carrot Fruit.*

The ripe fruit of *Daucus Carota*.

Habitat.—Indigenous.

Characters.—The fruits are about one-eighth of an inch long, greyish-brown in colour, and the ridges are covered with numerous hairs and spiny bristles. Odour slightly aromatic, taste pungent.

Composition.—The fruits contain a minute quantity of a volatile oil, sugar, and resin.

The root contains a peculiar colouring principle, carotin, which can be extracted with carbon bisulphide.

Cuminum. *Cumin.*

The ripe fruits of *Cuminum Cyminum*.

Habitat.—Indigenous to Egypt, cultivated in Europe.

Characters.—The fruits are usually attached to a short pedicel, and are about a quarter of an inch long, narrow at both ends, and a yellowish-brown colour. The ridges are

Compositæ.

usually covered with fine small hairs and are separated by a broad furrow; odour strongly aromatic, and their taste closely resembles caraway.

Composition.—The fruits contain about 8 per cent. of a fatty oil, .25 per cent. of a volatile oil, resin, and gum. The essential oil contains cymene, $C_{10}H_{14}$, cuminic aldehyde, $C_{10}H_{12}O$, the latter being oxidised into cuminic acid with hydrogen peroxide.

COROLLIFLORÆ.

COMPOSITÆ.

Absinthii Herba. *Wormwood.*

The dried tops and leaves of *Artemisia Absinthium*.

Habitat.—Indigenous to Europe.

Characters. — The tops are rounded, furrowed, and branching, bearing numerous leaves which are much divided. The capitula are arranged in paniced racemes, and the entire plant has a white hairy appearance, strong aromatic odour, and persistent bitter taste.

Composition.—The plant contains a volatile oil and absinthin. The volatile oil amounts to about 1.5 per cent., and consists chiefly of absinthol, $C_{10}H_{16}O$. This oil is used in preparing *absinthe*.

Absinthin, $C_{40}H_{58}O_9$, is obtained by precipitation from an infusion by means of tannin, and decomposing the tannate with lead oxide, and dissolving it out with alcohol. It is a white powder, freely soluble in ether, sparingly in cold water.

Calendula Flores. *Marigold Flowers.*

The dried fully expanded florets of *Calendula officinalis*.

Habitat.—Cultivated in European countries.

Characters.—The capitula are about two inches broad, with a flat receptacle and paleæ. The ray florets are in

Ericaceæ.

two rows, ligulate and pistillate, the disk florets tubular, five cleft, neuter or staminate. Both ray and disk florets are of a bright orange-yellow colour, and possess a heavy disagreeable odour.

Composition.—The flower heads yield a peculiar bitter principle, and a yellow coloured substance called calendulin.

Carthamus. *Safflower.*

The dried florets of *Carthamus tinctorius*.

Habitat.—Indigenous to India, cultivated in Europe.

Characters.—The florets are about one inch long, tubular, and when fresh of a bright yellow, becoming red on drying; odour disagreeable; taste bitter.

Composition.—The principal constituent is carthamin, $C_{14}H_{16}O_7$, to which it owes its value as a dyestuff.

ERICACEÆ.**Gualtheria.** *Winter Green.*

The dried leaves of *Gualtheria procumbens*.

Habitat.—Indigenous to the United States.

Characters.—The leaves are from one to two inches in length, obovate, faintly serrated, apex mucronate, texture coriaceous, colour bright green, odour aromatic, and taste astringent.

Composition.—The leaves contain a volatile oil, arbutin and ericolin, bodies similar to those contained in bearberry leaves. The volatile oil is generally prepared by distilling the entire plant, which yields about .6 per cent. When pure it is colourless, and possesses an agreeable odour and aromatic taste; when agitated with caustic soda it solidifies into a crystalline mass. The oil consists principally of methyl-salicylate, with a minute proportion of gualtherilene. The oil is also prepared from the twigs of *Betula lenta*, but large quantities are now made by distilling methyl acid sulphate with sodium salicylate. It is also occasionally adulterated with sassafras oil.

APOCYNACEÆ.**Abstoniæ Cortex.** *Dita Bark.*

The dried bark of *Abstonia scholaris*.

Habitat.—Indigenous to the Philippine Islands.

Characters.—The bark occurs in curved pieces of a light brown colour externally, and scaly, which is due to numerous fissures, and sometimes marked with black spots; the inner surface is greyish-brown and finely striated.

Composition.—The bark contains several constituents, such as ditaine, ditamine, and echicerin. Ditaine, $C_{22}H_{25}N_2O_4$, like ditamine, $C_{16}H_{19}NO_2$, is an alkaloid. The former occurs in much larger proportions, as much as 5 per cent. being found.

Allied Plants.—*Abstonia constricta* yields abstonia bark. This bark, like the preceding, contains various alkaloids, of which abstonine and porphyrine are the chief.

Wrightia antidysenterica yields Conessi bark, which contains the alkaloid conessine or wrightine.

Strophanthi Semen. *Strophanthus Seed.*

The ripe seeds of *Strophanthus hispadus*, *S. Kombe*, and other species.

Habitat.—Tropical Africa.

Characters.—The follicles are about ten inches or more in length, and contain about two hundred seeds, which are of a light brown colour, and attached to the apex is a long plumose hairy appendage; internally they are of a light yellow colour, inodorous, but with a strong persistent bitter taste; they are intensely poisonous.

Composition.—The seeds contain a considerable quantity of a fatty oil, which is entirely removed by percolating with petroleum ether, and from the marc alcohol removes about 4 per cent. of a glucoside strophanthin, which is the active principle. Strophanthin, $C_{20}H_{34}O_{10}$, may be prepared by precipitating by means of tannic acid, decomposing the

Loganiaceæ.

precipitate with lead oxide, and then extracting with alcohol, and mixing the solution with ether, which precipitates the strophanthin; this may be purified by recrystallisation from alcohol. It is readily decomposed into strophanthidin and glucose.

LOGANIACEÆ.**Curare.** *Curare.*

A soft extractiform mass, prepared probably from the bark of *Strychnos Castalnanæna* and other poisonous plants.

Habitat.—South America, used as an arrow poison.

Characters.—As met with it is a soft black extract, with an intensely bitter taste; it is sparingly soluble in alcohol, insoluble in ether, but readily in water.

Composition.—This substance contains an alkaloid curarine, which is probably allied to strychnine; it is precipitated from its aqueous solution by platinic chloride, with nitric acid it gives a deep red, and with sulphuric acid and bichromate of potassium a violet. Bohem has also isolated a second base, curine, which is non-poisonous.

Spigeliæ Radix. *Pinkroot.*

The dried root of *Spigelia marilandica*, Carolina Pink.

Habitat.—Indigenous to the Southern States of America.

Characters.—The rhizome is about four inches long, slightly branched and twisted, with numerous rootlets, brown in colour, odour aromatic, taste bitter, the rootlets are brittle and much wrinkled. Sometimes the entire plant is used. The stem is about twenty inches long, with opposite ovate lanceolate leaves, and bearing a terminal spike of flowers.

Composition.—The root contains a volatile oil, tannin, resin, and a bitter principle, and when distilled with lime it yields a volatile alkaloid spigeline.

Labiatae.

SOLANACEÆ.

Duboisia Folia. *Duboisia Leaves.*

The dried leaves of *Duboisia Myoporoides* and *D. Hopwoodii*.

Habitat.—Indigenous to Australia, where they form tree-like shrubs.

Characters.—The leaves are about four inches long, with short petioles, smooth, lanceolate, midrib prominent, margin slightly revolute and narrow towards the base, taste bitter.

Composition.—The leaves contain two alkaloids, namely duboisine and piturine, the latter being volatile. Duboisine has been proved by Ladenburg to be identical with hyoscyamine, as it yields the same compounds on saponification.

LABIATÆ.

Marrubii Herba. *Horehound.*

The dried leaves and tops of *Marrubium vulgare*.

Habitat.—Indigenous to Eastern Europe, cultivated in this country.

Characters.—The stem is about twelve or fourteen inches high, four sided, and covered with fine white hairs. The leaves are opposite and about one inch long, slightly cordate and prominently veined, pale green and downy on the upper surface, whitish beneath. The flowers are in dense whorls, and have a white corolla. The entire plant has a strong odour and bitter taste.

Composition.—The plant contains a volatile oil, resin, tannin, and a bitter principle, marrubin, which is removed from an infusion by agitation with charcoal; it has an intensely bitter and acrid taste.

*Lauraceæ.***Pogostemon Folia.** *Patchouli Leaves.*

The dried leaves of *Pogostemon Patchouly*.

Habitat.—Penang, Sylhet, and Malacca.

Characters.—The leaves are petiolate, ovate, two or three inches long, and biserrate margin, with a strong aromatic odour and bitter taste. The leaves are largely collected in Ceylon and India.

Composition.—The leaves contain a volatile oil, obtained by distillation; frequently the whole plant is employed for the same purpose. The oil contains a hydrocarbon and a stearopten; the greater portion distills over at 285° C.

LAURACEÆ.**Lauri Fructus.** *Bay Berries.*

The ripe fruit of *Laurus nobilis*.

Habitat.—Indigenous to the Levant.

Characters.—Bay berries are sub-globular oval drupes of a greenish-black colour, fragile, and slightly wrinkled. Each berry contains one seed, which has a peculiar odour and taste.

Composition.—The fruits contain about 20 per cent. of a fatty oil and 2 per cent. of a volatile oil, with a little resin. The oil is obtained by expression between hot plates, it is solid at ordinary temperature, melting at 104° F. to a clear dark green liquid; it yields on saponification, lauric palmitic, myristic, and oleic acids.

The Volatile Oil is obtained by distillation; it is pale yellow, and contains a neutral hydrocarbon, eugenol.

Adulteration.—*Oleum Lauri* is frequently adulterated; if the genuine oil is agitated with boiling alcohol, the alcoholic solution, when cold, should not turn red on the addition of ammonia (absence of turmeric or indigo).

Coniferæ.

CUPULIFERÆ.

Quercus Suber. *Oak Cork.*

Cork is the prepared suberous layer of the *Quercus Suber*.

Habitat.—Indigenous to Southern Europe.

Characters.—Cork forms an elastic suberous layer in the bark, which varies in thickness; it consists of quadratic cells, of which the cell walls have undergone cuticularisation, by which they become elastic and non-permeable to water. Frequently the cells contain a reddish powder, which is a phlobaphene.

Composition.—Cork contains about 5 per cent. of tannin, with small quantities of cerin and suberin. The latter is a fat, and yields stearic and phellonic acids on saponification.

GYMNOSPERMS.

CONIFERÆ.

Succinum. *Amber.*

A fossil resin which is the exudation of various extinct coniferous trees, Baltic amber being derived chiefly from *Pinites Succinifer*.

Habitat.—It is mainly obtained by digging on the South Eastern coast of the Baltic.

Characters.—It is hard, brittle, yellow or brown, translucent or transparent, fracture conchoidal; it readily dissolves in chloroform, sparingly in ether.

Composition.—Amber consists of a resin which on distillation yields the oil of amber of trade, this oil consisting of a number of hydrocarbons.

Taxus Folia. *Yew.*

The leaves and twigs of *Taxus baccata*.

Habitat.—Northern Europe.

Characters.—The leaves are closely arranged on the twigs, they are almost sessile, entire, linear curved, dark

Orchidaceæ.

glossy green on the upper surface, paler underneath, they are about 1 inch long. Frequently the peculiar fruit is found in the axil of the leaves.

Composition.—They contain tannin, volatile oil, and a poisonous alkaloid taxine, which is prepared by the tannin precipitation process. Milossin and a volatile alkaloid have been obtained from the leaves. The entire plant is poisonous, the presence of disk-bearing cells in the tissues is an important clue when examining for this plant.

E N D O G E N S .

PETALOIDEÆ.

ORCHIDACEÆ.

Tubera Salep. *Salep.*

The dried tubers of different species of *Orchis*, but principally those of *Orchis mascula*.

Habitat.—Indigenous to Europe.

Characters.—Salep is usually globular or pear-shaped, and about an inch long, flattened and wrinkled, with a scar at its apex, colour light yellow, texture horny, taste insipid.

Composition.—Salep contains a large quantity of starch, mucilage, and a small quantity of sugar. The starch is frequently prepared and used as food.

Vanillæ Fructus. *Vanilla.*

The dried unripe fruits of *Vanilla planifolia*.

Habitat.—Mexico, cultivated in Mauritius, Madagascar, and East Indies.

Characters.—The fruit is a triquetrous inferior capsule, in the best qualities about 12 inches long, dark brown; glossy, much wrinkled, and narrow towards the extremities,

Liliaceæ.

the surface is frequently covered with crystals of vanillin. The carpel is leathery, and filled with a blackish pulp in which are numerous seeds.

Composition.—Vanilla contains a fatty oil, resin, sugar, volatile oil, and vanillin about 1 to 2 per cent.

Vanillin (methyl protocatechuic aldehyde) is obtained from an alcoholic extract by diffusing it in water and agitating with ether; on evaporating the ether it remains in crystals. It is now largely prepared from coniferin, a glucoside contained in the sap of conifers.

Varieties.—Various South American vanillas are imported. They are obtained principally from *V. pompono*, *V. microcarpa*, and *V. Guianensis*.

LILIACEÆ.**Alii Bulbus. *Garlic.***

The dried bulb of *Allium Sativum*.

Habitat.—Cultivated in Europe.

Characters.—The bulbs are nearly globular and encircled in a few membranous scales, which cover numerous minute bulbs, which consist of a number of fleshy scales; odour pungent, taste acrid and burning.

Composition.—Garlic contains sugar, mucilage, and an essential oil. The volatile oil consists of a mixture of allyl oxide and sulphide (C_3H_5)₂S.

<i>Allied Species.</i> — <i>Allium Ceba</i>	...	Onion.
„ <i>Porrum</i>	...	Leek.
„ <i>Schœnoprasum</i>	...	Chives.
„ <i>Ascalonicum</i>	...	Shallot.

Convallaria. *Lily of the Valley.*

The entire plant of *Convallaria majalis*.

Habitat.—Indigenous to Europe.

Palmaceæ.

Characters.—The plant consists of a creeping rhizome throwing off two or three leaves and a small flower stalk bearing about ten flowers.

Composition.—The plant yields on distillation a small quantity of volatile oil which has a pleasant odour. The bitter principle is convallamarin, a glucoside which may be obtained by precipitation with tannic acid; on hydrolysis it yields convallamaretin and glucose.

Allied Plant.—*Polygonatum multiflorum*, Solomon's Seal. This also contains convallamarin.

PALMACEÆ.**Arecæ Semen. *Areca Nut.***

Synonym :—Betel Nut.

The ripe seed of *Areca Catechu*.

Habitat.—Indigenous to the East Indian Islands.

Characters.—The seed is about one inch in length, conical and rounded in form, with a flat slightly depressed base, light brown externally, darker internally, with numerous dark red veins, and numerous ramifying veins which originate at the hilum; embryo minute, the seeds are dense, odour faint, and taste astringent.

Composition.—*Areca* or Betel Nuts contain from 12 to 14 per cent. of fatty oil, which contains a considerable amount of palmatin, and is solid at ordinary temperatures; they also contain 15 per cent. of a peculiar tannin, which is sparingly soluble in water. On ignition the seeds yield from 2 to 3 per cent. of ash.

Palmæ Oleum. *Palm Oil.*

The oil obtained by expression from the fruits of *Elais Guineensis*.

Habitat.—Western Africa.

Palmaceæ.

Preparation.—The oil is obtained by submitting the fleshy sarcocarp of the fruit to pressure, or the fruits are boiled with water and the oil removed as it rises to the surface.

Characters.—Palm Oil is a soft buttery solid at ordinary temperature, with a pleasant fruity odour, and of a yellow or dark orange colour, which becomes paler on keeping, the oil at the same time becoming rancid. The fresh oil melts at 80.5° F., but on keeping the melting point rises to as high as 108° F. It is entirely soluble in ether, but only partly in alcohol.

Composition.—The oil consists chiefly of olein and palmitin, with a minute quantity of a characteristic ferment. It is largely employed in the manufacture of soap and candles, also for palmitic acid. The red oil of commerce consists of the crude oleic acid, obtained on the saponification of the oil by steam and ultimate separation of the palmitic acid by pressure.

Oleum Cocos. Coconut Oil.

The oil obtained from the seeds of *Cocos nucifera*.

Habitat.—Ceylon, India, and Africa.

Preparation.—The oil is obtained by expressing the seeds, after the removal of the hard woody shell, between hot plates, or by boiling with water and then separating.

Characters.—The oil is a soft white solid with a strong somewhat disagreeable odour, taste when fresh bland, but on keeping rancid and pungent; the melting point varies between 68° F. and 86° F. The lower melting oils are usually prepared by cold pressure. It is completely soluble in ether and carbon bisulphide, and is readily saponified with alkali.

Composition.—It consists of a mixture of the glycerides of myristic, palmitic, caproic, and lauric acids; when it is submitted to pressure it yields a pale liquid oil consisting of the glycerides of the lower fatty acids.

ACROGENS.

LYCOPODIACEÆ.

Lycopodium. Lycopodium.

The spores of *Lycopodium clavatum* and other species.

Habitat.—Indigenous.

Characters.—*Lycopodium* is a light yellow fine mobile powder, which on trituration becomes darker coloured and greasy, odourless and tasteless, floating on the surface of water; when thrown into a flame it burns rapidly, its combustion being accompanied with a peculiar noise; examined microscopically, the spores are seen to be pyramidal in form with a rounded base, the covering consisting of a network of fine meshes. It is principally imported from Germany.

Composition.—The spores contain a large proportion of a fatty oil, about 45 per cent., and about 4 per cent. of ash, with a small quantity of sugar.

Adulterations.—In commerce this substance frequently contains gypsum, starch, resin, and the pollen of different coniferæ.

FUNGI.

Sub-Order POLYPOREI.

Agaricus. White Agaric.

The entire fungus of *Polyporus officinalis*.

Habitat.—Found growing on the larch throughout Europe.

Characters.—The fungus consists of a large hymenophore, roundish or conical in form, usually about 8 inches broad and 3 or 4 inches thick, pale yellow externally, and the

Algæ.

hymenium consists of numerous minute yellow spores. In commerce it is nearly white, spongy, and friable; odour faint and taste bitter.

Composition.—It contains agaric acid, two resins, one of which is soluble in chloroform, and a small quantity of mycose sugar.

ALGÆ.**Fucus Vesiculosus.** *Bladder Wrack.*

The entire plant, *Fucus Vesiculosus*.

Habitat.—Found on the coasts of Britain.

Characters.—The plant consists of a long much branching thallus, with an entire margin and a prominent midrib, brown to green in colour when fresh, but black on drying, air vesicles in pairs, and the fructification situated at the extremities of the branches; odour characteristic of seaweed, taste saline and mucilaginous.

Composition.—Like most seaweed it contains minute quantities of iodine and bromine, a bitter substance, algin and alginic acid, and mannite.

ALKALOIDS.

The term alkaloid or alkali-like body is applied to certain organic compounds found in plants, from their supposed resemblance to ammonia. In most plants, and particularly in poisonous plants, these organic bases are found to possess in a marked degree the properties of the plant from which they have been isolated. They all contain nitrogen, and are generally found in combination with acids. Their constitution is not yet thoroughly understood, but many of them are regarded as derivatives of complex radicles, with ammonia, probably as amido or hydroxyamido compounds. Several of them contain no oxygen, in which case they are generally capable of distillation, and thus give rise to the

Alkaloids.

two groups, volatile and non-volatile alkaloids; the distinction is not a true one, inasmuch as most alkaloids are more or less volatile, a character which is taken advantage of in the application of the micro-sublimation tests. As nitrogenous compounds, they give many reactions typical of the more simple radicle ammonia; when mixed with soda-lime, or other strong caustic alkali, and heated, the whole of the nitrogen is evolved as ammonia, NH_3 . Their solutions in dilute hydrochloric acid form a characteristic precipitate with platinic or auric chloride, similar to the ammonium salt. Their basic properties differ widely, some acting as strong bases, readily combining with acids, but with a few the combination is so feeble that mere concentration of the solution produces dissociation; this is the case with the salts of caffeine. A few possess the property of combining with other bases, morphine and cupreine being typical examples; this character is explained on the assumption that the radicle possesses a phenolic as well as an amido grouping. Very frequently more than one of these organic bases are contained in the same plant together with other bodies, such as resins, tannins, and volatile oils, so that their extraction is sometimes a source of trouble, and is only accomplished after a long and tedious process. They are mostly soluble in alcohol, ether, chloroform, amyl alcohol, and benzene, and with difficulty in water. They are all precipitated from their solutions by phospho-tungstic or phospho-molybdic acids, and the double iodide of potassium with bismuth, mercury, or cadmium. Many of them give characteristic colour reactions with acids and other reagents, and not a few of them possess reducing properties.

Extraction.—Numerous methods have been proposed for the extraction of alkaloids, prominent amongst them being the process elaborated by Dragendorff, which consists of a combination of several others, the principal characteristic being (1) the agitation of the acid liquid with a series of solvents, and (2) the agitation of the same liquid rendered alkaline, with solvents.

Dragendorff's Process.—The drug, previously reduced to a fine state of sub-division, is digested in dilute sulphuric acid, the liquid removed, and the process repeated several times,

Alkaloids.

the liquids are mixed and concentrated until the mixture acquires a sirupy consistency ; to this is added four times its volume of alcohol, macerated for some time, and then filtered, the residue in the filter washed with alcohol, and the washings added to the filtrate. The filtrate is distilled until free from alcohol, water added, and filtered. The acid solution is now agitated with petroleum ether several times, and the products evaporated on a water bath. Piperin, essential oils, and colouring matter are removed by this solvent. The aqueous solution is now similarly agitated with benzene, which removes small quantities of eserine, veratrine, delphinine, berberine, theine, cubebine. The watery fluid is now agitated with chloroform in the same way ; this removes jervine, theobromine, narceine, papaverine, and cinchonine. The liquid is again shaken with petroleum, to remove any trace of chloroform, after which the solution is rendered alkaline with ammonia, and agitated with petroleum ether, which removes strychnine, brucine, quinine, emetine, veratrine, conine, sparteine, and lobeline. The alkaline liquid is now agitated with benzene, which removes eserine, strychnine, brucine, codeine, atropine, hyoscyamine, quinine, cinchonine, aconitine, veratrine, sabadilline, narcotine, and thebaine. Agitation is continued with chloroform, which removes the last traces of cinchonine, narceine, and papaverine ; the residual liquid is finally agitated with amylic alcohol, which removes morphine and solanine.

A more simple process, by Loesch, was proposed some time since, which gives fairly satisfactory results. This method consists in thoroughly extracting the drug with alcohol containing 10 per cent. of tartaric acid ; the alcohol removed by distilling until the residue forms a soft extract ; this is dissolved with water, after which half its volume of strong solution of potassium alum is added, and then solution of ammonia or carbonate of sodium until alkaline in reaction. The muddy liquid is now gently evaporated on a water bath to dryness, and the alkaloid extracted by a suitable solvent. For liquid volatile alkaloids Loesch recommends distilling the alcoholic extract with slaked lime, collecting the distillate

Alkaloids.

in dilute sulphuric acid, evaporating the solution of the sulphate to dryness, and removing the alkaloidal sulphate by means of alcohol, the insoluble residue consisting of ammonium sulphate. The alkaloid is precipitated from the sulphate by sodium bicarbonate, and removed by agitation with a suitable solvent.

PHARMACOPŒIAL PROCESSES.

Aconitine.

Exhaust the aconite root with rectified spirit, recover the spirit by distillation, add to the residual extract twice its weight of boiling water, cool, and filter. Precipitate the aconitine by addition of ammonia in slight excess, gently warm, collect the precipitate, and dry. Powder the dried precipitate, and digest in successive quantities of ether, recover the ether by distillation, and dissolve the residue in dilute sulphuric acid, and precipitate the alkaloid by addition of dilute solution of ammonia, collect the precipitate, wash, and dry.

Atropine.

Exhaust the belladonna root with rectified spirit, add to the tincture slaked lime, which precipitates colouring matter and malic acid. Filter, add dilute sulphuric acid to precipitate lime, and form atropine sulphate, filter, and distil off the spirit, add the water, and warm until the alcohol is entirely dissipated; when cold carefully add a solution of carbonate of potassium to neutrality. Filter, and add an excess of carbonate of potassium, agitate with chloroform, remove the chloroformic solution, distil off the chloroform, dissolve the residue in alcohol, digest with animal charcoal, filter, evaporate, and cool until colourless crystals are obtained.

*Alkaloids.***Beberine Sulphate.**

Exhaust the beberine bark with dilute sulphuric acid, concentrate the solution, and add gradually slaked lime, taking care to keep the liquid slightly acid, filter, add solution of ammonia to the filtrate until faintly alkaline. Collect the precipitate, wash, and dry on a water bath, powder it, and boil with alcohol, pour off the clear solution, and distill off the greater part of the spirit. Dissolve the residue in dilute sulphuric acid, and evaporate to dryness. Dissolve the residue in cold water, filter, and evaporate to a sirupy consistence, spread on glass plates, and dry at a temperature not exceeding 140° F.

Caffeine.

The dried coffee seeds are thoroughly exhausted by aqueous infusions, colouring and astringent matters removed, and the solution evaporated to crystallise.

Cinchonidine Sulphate.

The sulphate of this alkaloid is obtained from the mother liquors of the crystallisation of sulphate of quinine by further concentration. It is afterwards purified by crystallisation from alcohol, and finally from hot water.

Cinchonine Sulphate.

The mother liquors of the crystallisation of the sulphates of quinine, cinchonidine, and quinidine, are treated with caustic soda, the alkaloid collected, well washed with spirit to free it from other alkaloids, re-dissolved in dilute sulphuric acid, decolourised with animal charcoal, and set aside to crystallise.

*Alkaloids.***Cocaine Hydrochlorate.**

The leaves are first exhausted with acidulated alcohol, the alcohol distilled off, and the solution rendered alkaline with carbonate of sodium, and then agitated with ether; the ethereal solution separated and evaporated. The cocaine purified by redissolving in dilute acid, precipitating with sodium carbonate, and taken up with ether, decolourising, neutralising the residue with dilute hydrochloric acid, and crystallising.

Codeine.

The ammoniacal mother liquors from which morphine has been obtained are evaporated and treated with water, the alkaloid precipitated with caustic potash, and purified by recrystallisation from ether.

Morphine Hydrochlorate.

Opium is exhausted by several macerations in water, and the liquids united and evaporated to a small bulk, solution of calcium chloride added, and the whole evaporated until it becomes solid on cooling. The mass is wrapped in calico, and submitted to powerful pressure, the residual cake is dissolved in boiling water, and the solution filtered, and the residue washed. The filtrate and washings evaporated as before, cooled, and solidified, and again pressed; the process repeated a third time, after which the cake is dissolved in boiling water, animal charcoal added, and digested for twenty minutes, filtered, and the morphine precipitated by ammonia; the alkaloids washed, dissolved in dilute hydrochloric acid, evaporated, and set aside to crystallise.

*Alkaloids.***Physostigmine.**

Exhaust the seeds with alcohol, distil off the spirit, and dissolve the extract in water, precipitate the alkaloid by sodium bicarbonate, agitate with ether, decant the ethereal layer, and evaporate to dryness.

Pilocarpine Nitrate.

An alcoholic extract is first prepared, then dissolved in water, rendered alkaline with caustic soda, and agitated with chloroform; the chloroformic solution decanted, evaporated, and the residue neutralised with nitric acid, dissolved in alcohol and crystallised.

Quinine Sulphate.

Various kinds of Cinchona or Cuprea bark are exhausted by spirit after the addition of lime, or by the addition of an alkali to an acidulated aqueous infusion, with subsequent neutralisation of the alkaloid by sulphuric acid, and purification of the resulting salt.

Strychnine.

The drug is first finely disintegrated, and then exhausted by digestion in a mixture of spirit and water, the alcohol recovered by distillation, and the residue evaporated to a small bulk, and filtered. To the filtrate, solution of lead acetate is added as long as a precipitate is thrown down; filter and wash the precipitate, evaporate the mixed filtrate and washings to a small volume, and add ammonia in slight excess. Let the mixture stand, collect the precipitate,

Alkaloids.

wash, and dry on a water bath; boil with successive portions of spirit until exhausted. Distil off most of the spirit, evaporate to a small bulk, and set aside to crystallise, decant the mother liquor, and wash the crystals with a mixture of alcohol and water, redissolve in a small quantity of boiling alcohol, and set aside to crystallise.

Veratrine.

The drug is first macerated in boiling water, then dried, beaten, and the capsules removed by winnowing. The seeds are ground, and exhausted with alcohol; the spirituous solution concentrated, and while hot poured into a large quantity of cold water; it is then filtered and the residue washed well with water, and ammonia added in excess; the precipitate is collected, washed, and dissolved in dilute hydrochloric acid, decolourised with animal charcoal, filtered, and cooled. To the liquid, ammonia is added in excess, the precipitated alkaloid collected, washed, and dried.

Quantitative Estimation of the Alkaloids.

When a more exact determination of the alkaloids is required, some method of titration is used for that purpose. Amongst one of the simplest processes is the use of a deci-normal sulphuric acid solution made by dissolving 4.9 grams of absolute sulphuric acid in one litre of distilled water. 1cc. contains .0049 of H_2SO_4 . This method is tolerably accurate when only one alkaloid is present, and is particularly useful in the case of volatile liquid alkaloids, a measured volume being taken, and the excess titrated back with deci-normal sodium hydrate, using litmus or phenolphthalein as an indicator.

Another method is to employ Mayer's reagent, which is prepared by dissolving 49.8 grams of potassium iodide in 100 cc. of distilled water, and 13.546 grams of mercuric

Alkaloids.

chloride in 500cc. of distilled water, mixing the two solutions, and making up the measure to one litre. Process :—the solution containing the alkaloid, which may be an acidulated infusion of the drug, to which a little alcohol has been added to precipitate mucilaginous substances, &c., is then filtered and boiled to remove spirit, and titrated with the solution, the finish of the reaction is determined by a drop of the filtered liquid ceasing to give a precipitate with a drop of the reagent.

One cubic centimètre of this reagent precipitates—

	Gram.		Gram.
Quinine	... 0·0108	Brucine	... 0·0233
Quinidine	... 0·0120	Aconitine	... 0·0268
Cinchonine	... 0·0102	Physostigmine	0·01375
Morphine	... 0·0200	Conine	... 0·00416
Narcotine	... 0·0213	Nicotine	... 0·00405
Atropine	... 0·0145	Veratrine	... 0·0269
Hyoscyamine	... 0·00698	Emetine	... 0·0189
Strychnine	... 0·0167	Berberine	... 0·0425

It is necessary to ascertain approximately the amount of the alkaloid present, as the results are only accurate when the strength of the solution is about 1 in 200. The solution must always be acid, as ammonia, if present, would be estimated as alkaloid.

Group Reagents for Alkaloids.—As the alkaloids give numerous colour reactions with certain reagents, the sub-joined list will be found to be useful in their examination :—

Potassio-bismuthic Iodide (Thresh's Reagent). Prepared by adding 90 grains of potassium iodide to one fluid ounce of liquor bismuthi, and then adding 90 minims of pure strong hydrochloric acid. This solution throws down orange-coloured precipitates even with minute traces of alkaloid.

Phospho-tungstic Acid (Scheibler's Reagent). Prepared by dissolving sodium tungstate in half its weight of phosphoric acid, sp. gr. 1·13, and setting aside for a week. Phospho-tungstic acid separates in crystals. These are collected and dissolved in water.

Alkaloids.

Phospho-molybdic Acid. Prepared by adding to a solution of sodium phospho-molybdate strong nitric acid, and then diluting with water, so that 10 parts of the solution contain 1 of salt.

Sulpho-molybdic Acid (Fröhde's Reagent). Prepared by dissolving 5 grams of ammonium molybdate in one litre of strong sulphuric acid. This reagent gives some characteristic colour reactions which are intensified on gently warming.

Picric acid. Gives yellow precipitates.

Iodine in Potassium Iodide. Prepared by dissolving iodine in a strong solution of the iodide.

Amongst numerous other group reagents may be enumerated silico-tungstic acid, potassium bichromate, tannin, gallic acid, chlorides of platinum and gold, mercuric chloride, sulphuric, nitric, and hydrochloric acids, chlorine and bromine water, &c., &c.

Colour Reactions.—When approximately pure, alkaloids possess certain colour reactions which are generally characteristic of them. The table on pp. 378-9 gives a summary of the most important.

Amongst other reactions may be mentioned their absorption spectra, polarization, and microsublimation. Microsublimation is usually performed with two small watch glasses, which float on mercury or fusible metal, a delicate thermometer being attached to the metal. In this observation fusing and subliming temperatures are observed.

ALKALOID.	Pure H ₂ SO ₄	H ₂ SO ₄ + HNO ₃	H ₂ SO ₄ + Sugar.	Fröhde's Reagent.	HNO ₃	Pure HCl.	H ₂ SO ₄ + K ₂ Cr ₂ O ₇	Fe ₂ Cl ₆	Other Reactions.
Aconitine ...	Grad. Violet	Grad. Violet	Deep Red	Yellow	Red- dish	Color- less	...	Yellow	Phospho-molybdic acid rapidly turns blue.
Atropine ...	...	...	Violet	Brown ...	...	...	Dark Col'd	...	Dilates the pupil. Reduces mercuric chloride, forming red precipitate
Berberine ...	Olive Green	Olive Green	...	Brown Green	Red- dish	...	...	...	Dissolved in a little HCl., and then a few drops of chlorine water added, becomes red.
Brucine ...	...	Red	...	Red	Red	...	Orange	...	Boiled with perchloric acid it acquires a Madeira tint. Chlorine water, evanescent red.
Caffeine ...	...	...	...	...	...	...	...	...	Dissolve in chlorine water or nitric acid, and evaporate to dryness, then add ammonia; a fine purple red colour is produced.
Cinchonine...	...	...	...	...	...	...	...	...	Does not become green with chlorine and ammonia, and is insoluble in ether.
Cinchonidine	...	...	...	...	...	...	...	...	Precipitated from its neutral solution by KNaC ₄ H ₄ O ₆ does not become green with chlorine water and ammonia.
Colechicine and Colehiceine	Yellow	Blue	Yellow	Yellow	Blue	...	Green Brown	...	Dissolve in H ₂ SO ₄ , and add HNO ₃ , allow blue colour to fade, then add KHO, a red colour is produced.
Conine ...	...	...	...	...	...	...	...	...	Forms a crystalline mass with HCl.

Codeine ...	...	Grad. Blue	Red	Deep Blue	Yellow	...	Olive Green	...	Warm with a drop of H_2SO_4 , then add Fe_2Cl_6 , a deep blue is produced.
Delphinine ...	...	...	...	...	Re-mains clear	Re-mains clear	...	...	Dissolve in H_2SO_4 , and add bromine, a violet colour is formed.
Emetine ..	Brown Green Yellow Red	Brown Green ...	...	Red Green	...	...	...	..	Dissolve in Fröhde's reagent, add HCl , deep blue is formed.
Gelsemine ...	Yellow Green	Yellow Green Violet	...	...	Color-less	...	...	...	\text{H_2SO_4 , and Ce_2O_3 , deep cherry red.
Jervine ...	...	Yellow Green Violet	Red	Violet	Yellow	...	Brown	Blue	Reduces, K_4FeCy_6 . AgNO_3 , HIO_3 &c.
Morphine ...	Red	Reddish Violet	...	...	...	...	...	...	Evaporate solution in dilute H_2SO_4 , fine red.
Narcotine ...	Grad. Red	Grad. Red	...	...	Red	...	...	...	\text{CaCl_2 , solution coloured red.
Physostigmine	...	...	...	...	...	...	Green Faint Yellow	...	Chlorine water and ammonia, fine green, red brown with addition of K_4FeCy_6 .
Pilocarpine...	...	...	...	Green	...	...	Faint Yellow	...	As quinine.
Quinine ...	...	...	...	Green	...	...	...	...
Quinidine ...	...	...	...	Yellow	Wine Red	...	Blue to Violet	Brownish Green Gives a ppt.	Blue colour, more permanent with H_2SO_4 and Ce_2O_3 .
Sabadilline and Sabatrine ...	Fine Cherry Red	Fine Cherry Red	Reddish Violet	Yellow	...	...	...	...
Strychnine...	...	...	...	...	...	...	...	...
Veratrine and Veratridine	Fine Cherry Red	Fine Cherry Red	Grad. Blue Violet	Cherry Red	Yellow	Red	...	...

GLUCOSIDES.

Amongst the numerous products found in the tissues of plants are a class known as glucosides, which are ethereal or saline compounds of dextrose. The glucosides found in plants have never been produced artificially, but a series of compounds analogous to them can be formed when glucose and the fatty or aromatic acids are heated together for some time, the temperature being maintained at 120°C . Mannitanides are thus modified glucosides. According to Berthelot, they are derivatives of glucosan, because, when decomposed with alkalies, they produce glucosan, $\text{C}_6\text{H}_{10}\text{O}_5$, and when hydrolised, glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, is formed. Many of the glucosides are bitter principles, and nearly all of them are soluble in alcohol and water; but most of them are insoluble in ether; only a very few of them contain nitrogen.

Extraction.—Various methods are employed for removing these principles from their aqueous solution. No generalised method is adopted. The drug may first be exhausted with water, and the aqueous solution concentrated, and the process of agitation as for alkaloids adopted. Benzene removes from the acid solution colocynthin, elaterin, populin, and digitalin. Chloroform removes helleborein, æsculin, senegin, syringin; for some, precipitation by means of plumbic acetate is adopted, or absorption by charcoal, and subsequent extraction with alcohol; many require special treatment. For the more important glucosides processes are given in detail under their respective heads.

Examination.—Having proved the glucosidal nature of the substance by hydrolysis, advantage of the reaction is taken for a complete examination of the body. Hydrolysis of the glucoside is accomplished by boiling the body with dilute sulphuric or hydrochloric acid, using 2 per cent. acid. The rapidity with which decomposition takes place

Glucosides.

varies considerably; with some, several hours boiling is required, while with others only a few minutes are necessary. When hydrolysis is sluggish, the boiling should be accomplished under somewhat higher pressure, and using acidulated alcohol in place of water. The products resulting from hydrolysis vary somewhat in their solubility in water, many being insoluble even in boiling solutions, and thus render the liquid turbid. Hydrolysis being completed, the solution is allowed to cool, and the precipitate, if any, removed; or, if the solution remains clear, the substance other than glucose may be extracted by the process of agitation with various solvents. The substance other than glucose may be a phenol, as hydroquinone from arbutin, or it may be alcoholic in its character, as saligenin from salicin, or more than one product may result from hydrolysis, as benzaldehyd and hydrocyanic acid from amygdalin; in many the substance produced may be closely related to the glucoside. In all instances this body should also be examined. The aqueous solution containing the glucose is next examined; should the solution be alcoholic, water is added, and the solution boiled until free from alcohol, the acid is removed by adding barium carbonate, and filtering, the filter being washed, and the washings added to the filtrate. The glucose is examined by a saccharometer, to determine its optical properties. Should a quantitative analysis be required, an aliquot portion is mixed with yeast and introduced into a eudiometer over mercury, and the carbonic anhydride, if any, determined; sometimes the glucose is an unfermentable one. The quantitative determination can also be made by means of Fehling's solution, 10 cc. of which is equal to .05 gram of glucose; this is the most reliable method.

Group Reagents.—The principal group reagents for glucosides are strong sulphuric, hydrochloric, and nitric acids, ferric chloride, potassium bichromate and sulphuric acid, Fröhde's reagent, &c. The subjoined is a list of the more important glucosides :—

Bitter Principles, &c.

Amygdalin.	Glycyrrhizin.
Æsculin.	Helleborein.
Arbutin.	Helleborin.
Apiin.	Helicin.
Bryonin.	Hesperidin.
Cathartic Acid.	Indican.
Colocynthin.	Jalapin.
Cotoin.	Laurocerasin
Coniferin.	Myrosin.
Convolvulin.	Populin.
Crocin.	Phloridin.
Daphnin.	Quercitrin.
Digitalin.	Salicin.
Datiscin.	Scillain.
Elaterin.	Saponin.
Fraxin.	Senegin.
Gentiopierin.	Syringin.

Pharmacopœial Processes for Official Glucosides.

No. 1. *Elaterinum*. *Elaterin*.—Obtained by exhausting elaterium with chloroform, adding ether to the chloroformic solution, collecting the precipitate, washing the latter with ether, and purifying by recrystallisation from chloroform.

No. 2. *Salicinum*. *Salicin*.—Obtained by first treating the bark with hot water, removing tannin and colouring matter from the decoction, evaporating, purifying, and recrystallising.

Bitter Principles and Colouring Matters.

Under this class is grouped a number of organic bodies of whose constitution little is at present known. In physical and chemical characters they differ widely, some possessing marked acid properties, whilst others yield metallic compounds with strong bases. This latter character, of some amongst these bodies, undoubtedly depends on the presence of hydroxyl groups situated as in phenols, as some of them

Bitter Principles, &c.

can be transformed into phenolic bodies. They also differ widely in their action on the animal economy, some acting as powerful purgatives, others as pure bitter tonics, whilst some are markedly poisonous.

Extraction.—As these bodies differ so widely amongst themselves, no general method can be adopted in isolating them; most of them are soluble in water and alcohol, some in chloroform and ether; under their botanical sources methods of extraction have already been described.

From the fact that they are non-nitrogenous substances, they have frequently been designated neutral principles; the following are those that are best known:—

Bitter Principles.

Aloin.
 Antiarin.
 Cusparin.
 Cascarillin.
 Columbin.
 Kosin.
 Picrotoxin.
 Quassin.
 Santonin.

Colouring Matters.

Brazilin.
 Carthamin.
 Curcumin.
 Carotin.
 Chlorophyll.
 Hæmatoxylin.
 Santalin.
 Erythrolitmin.
 Azolitmin.

Group Reagents.—Amongst the numerous test reagents used for these principles are sulphuric and nitric acids, potassium hydrate, plumbic acetate, hydrogen peroxide, chromic acid, ferric chloride, and Fehling's solution. Distillation with zinc dust is a test applied to determine if they belong to the anthraquinone class of compounds, anthracene or methyl-anthracene being formed as one of the products of distillation.

Pharmacopœial Process for Extraction of Bitter Principles.

Aloin is extracted by solvents and purified by recrystallisation.

Santonin. The santonica is first boiled with water containing hydrate of calcium, the decoction strained, and the residue expressed strongly. The decoction is evaporated to

Resins.

a small bulk, and while still hot hydrochloric acid is added to it, and the liquid set aside for five days for the santonin to crystallise, the oily liquid being then removed from the surface of the solution. The santonin is collected and washed first with water and afterwards with weak ammonia solution, and finally with cold distilled water, and dried. The crystals are then mixed with animal charcoal, digested in alcohol and boiled for ten minutes, filtered, and the filtrate set aside in a dark place for the santonin to crystallise.

Resins.

This class of plant constituents, which are widely distributed throughout the vegetable kingdom, are in some instances simple bodies, whilst in others they are very complex substances, consisting of more than one resin. Resins of a simple nature may be either an acid, the anhydride of an acid, or an indifferent body, and they may be readily soluble in alcohol, or in caustic alkaline solutions. The more complex resins are usually soluble in alcohol, ether, or chloroform, and can be more or less saponified with caustic potash. As these bodies are found in plant-tissues more or less mixed with other constituents, they are usually classified under different heads, of which the subjoined are the more important:—

Oleo-Resins.—These generally consist of the solution of a resin or resins in an essential oil. They vary considerably in their appearance, some being fluids of different degrees of viscosity, this character depending upon the amount of the resin present, whilst others are hard amorphous masses, and a few are soft substances. They are all more or less soluble in alcohol or ether, and become more fluid on the application of heat. When submitted to distillation with water they yield the essential oil, the resin proper being left as an amorphous mass. Those which are solid usually melt when heated, and burn with a smoky luminous flame, emitting at the same time a characteristic odour. On the addition

Resins.

of water to their alcoholic solution precipitation of the resin takes place. They are sometimes incorrectly described as *balsams*.

Gum-Resins.—These differ essentially from the preceding by consisting of a mixture of resin or resins with varying quantities of gum. They are somewhat hard masses, always amorphous, and when triturated with water yield an emulsion varying in colour. They usually char when heated, and burn with a smoky flame, and sometimes emit acrid fumes. When macerated in alcohol or ether the resin is removed, leaving a more or less coloured residue of gum, which latter frequently differs in its properties from gum acacia. Some gum-resins contain small quantities of essential oil, as is the case with myrrh, &c.

Balsams.—These are combinations of oleo-resins with one or more of the aromatic acids, the acids usually found being benzoic or cinnamic. They are mostly of an aromatic character, having an agreeable fragrant odour and somewhat pungent taste. When ignited they burn with a smoky luminous flame and evolve a fragrant odour. They are, for the most part, soluble in alcohol or ether, or a mixture of the two, the solution being incompatible with water. They are met with of varying degrees of consistency, some being fluid or semifluid, whilst others are in hard compact masses, when they are known as *balsamic resins*.

Resins, when purified, are nearly all amorphous, some being closely related to the terpenes, and most probably are formed from those hydrocarbons, either by absorption of water or by gradual oxidation. Most resins give characteristic reactions when fused with caustic potash or submitted to dry destructive distillation.

Among the group-reagents used for testing resins are chloroformic solution of bromine, strong nitric, sulphuric, and hydrochloric acids, impure chloral, sulphuric acid, sugar, and alkalies. Fusion with potassic hydrate is a characteristic test, the principal products resulting from the action being phloroglucin, protocathechuic acid, resorcin, pyrogallol, and para-oxybenzoic acid. The following are some of the more important resins classified under their headings:—

*Resins.**Oleo-Resins.*

Copaiba.	Thus.	Burgundy Pitch
Elemi.	Turpentine.	Canada Balsam.

Gum-Resins containing Volatile Oil.

Asafoetida.	Myrrh.	Ammoniacum.
Galbanum.	Olibanum.	Bdellium.

Gum Resins.

Scammonium.	Gamboge.	Euphorbium.
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Balsams.

Balsam Peru.	Balsam Tolu.	Storax.
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Resins.

Dammar.	Mastic.	Sandarac.
Guaiacum.	Dragon's Blood.	Amber.
Acaroides.	Copal.	Rosin.
Podophyllin.	Cimicifugin.	Animi.
Jalap.	Scammony.	

Balsamic Resin.

Benzoin.

Products obtained on fusion with caustic potash on the following bodies :—resins, colouring principles, and allied bodies.

Asafoetida	=	Protocatechuic Acid and Potassium Sulphide.
Balsam of Peru	=	Protocatechuic Acid.
Balsam of Tolu	=	Protocatechuic Acid.
Cinchona, Red	=	Protocatechuic Acid.
Male Fern Resin	=	Phloroglucin and Butyric Acid.
Kino	=	Phloroglucin and Protocatechuic Acid.
Santalín	=	Resorcin.
Hæmatoxylin	=	Pyrogallol.
Storax	=	Pyrocatechin and Protocatechuic Acid.
Galbanum	=	Resorcin.

Tannins.

A great many of the resins yield phloroglucin and protocatechuic acid.

Destructive distillation of resins and their allied bodies yields chiefly pyrogallol or pyrocatechin and pyrogenated oils.

Pharmacopœial Process for Resins and Oleo-Resins.

Jalap Resin. Macerate the jalap in No. 40 powder in rectified spirit; then transfer to a percolator and exhaust by percolation. Add to the tincture a little water, and recover the spirit by distillation. Remove the residue while hot to an open dish, and allow it to become cold. Pour off the supernatant fluid from the resin, wash with hot water, and dry on a porcelain plate by the heat of a water bath.

Podophyllin Resin. Podophyllum rhizome, in No. 40 powder, is exhausted by percolation with rectified spirit. The tincture is distilled to recover the greater portion of the spirit, and the residual liquid poured into three times its volume of water, constantly stirring; the mixture is allowed to stand for the resin to deposit. The resin is washed with distilled water and dried in a stove.

Scammony Resin. Scammony root is exhausted by maceration and percolation, and the tincture treated in the same way as for jalap resin. It may also be prepared in a similar way from crude scammony.

Oleo-Resin of Cubebs. Cubebs in coarse powder is used and is percolated with ether until exhausted. The ether is recovered by distillation, the residue allowed to stand until waxy or crystalline matter ceases to be deposited, the oleo-resin is then decanted.

The Tannins.

The astringent principles of plants are the so-called *tannins*; they are found widely diffused throughout the vegetable kingdom. The greater number of them are of a glucosidal nature, but many exist which do not allow of

Tannins.

being classed as such, their constitution at the present time being very imperfectly understood. Many of the glucosidal tannins yield on hydrolysis glucose and gallic acid, and others in place of glucose yield phloroglucin. The glucosidal nature of tannins may be determined in the same manner as true glucosides, viz., hydrolysis with 2 per cent. sulphuric acid, agitation of the liquid with solvents, removal of the acid with barium carbonate, and examination of the watery residue for glucose. A number of tannins, when treated in this way, yield reddish-brown amorphous and difficultly soluble residues; these residues are the *phlobaphens*, which frequently exist in the plant from the natural decomposition of the tannin, as oak-red and krameria-red. Phlobaphens are generally soluble in solution of ammonia and alcohol. Chemically they are closely related to many resins, and, like them, yield proto-catechuic acid and phloroglucin on fusion with caustic potash, but differ from them in their solubility in solution of ammonia, sugar, and tannic acid.

Extraction.—Most tannins are readily soluble in water, and are in consequence easily removed by maceration, or decoction with water. From the proneness of the tannins to decomposition, the separation of a *pure tannin* is almost impossible, many of them yielding more than one decomposition product (Grünning). In purifying tannins it is preferable to dissolve an alcoholic extract in distilled water, and fractionally precipitate the tannin by means of plumbic acetate, collecting only the intermediate precipitates. The lead tannate should be immediately washed and decomposed with a brisk current of sulphydric acid, and the filtrate evaporated *in vacuo*, and finally dried over calcium chloride or sulphuric acid. Some tannins may be removed from the aqueous solution after decomposition of the lead tannate, by agitating the liquid with acetic ether, decanting the ether and allowing it to evaporate.

Reactions of Tannins.—Their solutions are precipitated by the addition of gelatine solutions and animal membranes, forming *leathers*. On addition of ferric chloride, they give a greenish-black or bluish precipitate; they are also pre-

Tannins.

precipitated from their solutions by alkaloids, or by plumbic acetate. Agitated with potassium cyanide solution they give a transient rose-red colour; with potassium hydrate or slaked lime the solutions rapidly acquire a brown colour. When boiled with soluble copper or silver salts they gradually reduce them.

Estimation.—On account of the extreme variability of tannins, their estimation is rendered one of exceeding difficulty, and on that account numerous processes have been put forward from time to time, of which the following are the more important:—

Perret's Process.—An extract is first prepared by twice boiling a weighed portion of the drug with water, evaporating the solution to 100 cc., then cooling it to 70° C. To this decoction is added a solution of 1 part of dry albumen in 4 parts of water, as long as a precipitate is formed. The mixture is heated to boiling point, and then a 20 per cent. solution of aluminium sulphate is run in until the precipitate settles. The precipitate is collected, washed, and dried in a hot air oven. The weight of the filter, aluminium sulphate, and albumen, being deducted, the remainder is taken as tannin.

*Proctor's modification of Löwenthal methods.**Requisite Materials.*

Standard Permanganate Solution.	1 gm. per litre.
Indigo Carmine Solution.	5 gm. with 50cc.
	of strong sulphuric acid, per litre.
Nelson's Gelatine Solution.	20 gm. per litre.
Dilute Sulphuric Acid	10 per cent. by volume.

Kaolin and Sodium Chloride.

20 cc. of indigo carmine solution require 15 cc. of permanganate for complete decoloration.

The principle of this process consists in first determining the amount of oxidisable matter in an infusion made with 10 grams of the substance per litre; then removing the tannin by precipitation with gelatine solution, dilute sul-

Tannins.

phuric acid, kaolin and sodium chloride, and titrating the filtrate to determine oxidisable substances other than tannin. The amount of permanganate required for the indigo-carmin, and substances other than tannin, deducted from the number of cc. required for the first titration, will give the number required for the tannin.

Process.—10 cc. of the infusion is added to a flask containing 700 cc. of distilled water, then 20 cc. of the indigo-carmin solution and 10 cc. of dilute sulphuric acid are added. The permanganate is now run in until the blue colour of the liquid changes to a clear yellow, when the quantity of permanganate used is noted (*a*). Fifty cc. of the infusion is now added to 28.6 cc. of gelatine solution and 8 grammes of kaolin and some salt, then the liquid made up to 100 cc., thoroughly shaken and thrown on a filter; 20 cc. of the filtrate is now titrated as (*a*) with the same quantity of indigo-carmin and dilute sulphuric acid, and the quantity of permanganate noted (*b*). Twenty cc. of the indigo-carmin is next titrated with permanganate and noted (*c*). The amount of permanganate required for the tannin is therefore, $a - b + c = d$, where *b* and *c* denote the amount required for indigo-carmin and colouring matter, *d* representing the difference on that required for tannin.

Permanganate.

Example 1 :—10 cc. of astringent infusion

with 25 cc. of indigo-		
carmin	required	16.6 cc.
Second experiment	„	16.5 cc.
		<hr/>
		33.1 cc.
50 cc. of indigo-carmin	„	13.2 cc.

Therefore	...	33.1
		13.2
		<hr/>
		19.9 cc.

So that 20 cc. of the infusion required 19.9 cc.

Tannins.

Permanganate.

Example 2 :—50 cc. filtrate from gelatine		
treatment with 25 cc. of		
indigo-carminine	required	11.2 cc.
Second experiment	„	11.1 cc.
		<hr/>
		22.3 cc.
50 cc. of indigo-carminine	„	13.2 cc.
		<hr/>
Colouring and other oxi-		
disable matter	required	9.1 cc.

Therefore $19.9 - 9.1 = 10.8$ cc. of permanganate required for the tannin in 20 cc. of the infusion representing the tannin of .2 gram of the astringent substance. From the differences amongst tannins, Mr. H. R. Procter prefers to express percentage in terms of crystallised oxalic acid, whereby a more uniform and fair comparison can be made : thus, if (y) represents the amount of permanganate requisite to oxydise 10 cc. of decinormal oxalic acid, then— $c : 10.8 :: 6.3 = x$ where x represents the percentage of tannin expressed as oxalic acid. Neubaur gives .063 of oxalic acid as equal to .04157 of gallo-tannic acid.

A more recent modification of this process has been instituted by Prof. Von Schroeder, which consists in standardising the permanganate with *pure tannin*, and in removing the tanning substance from the infusion by means of powdered hide, instead of gelatine.

Eck's Process.—This process, like the first, is a gravimetric one. Two pieces of pelt or depilated hide are taken of equal weight, freed from all substances soluble in water and petroleum ether, by digestion in these solvents, and then dried. One is macerated in distilled water and the other in an infusion of the tanning substance for some time, then removed, dried in an air bath, and weighed, the increase of weight being regarded as tannin. The specific gravity of the solution may be determined before and after maceration, the loss in this case being calculated as tannin. This method is a rough one and serves only for an approximate estimation.

Sugars.

Amongst other processes employed, there is precipitation by means of cinchonine sulphate (Wagner), precipitation with tartar emetic (Gerland), ferric acetate (Handtke), cupric acetate (Fleck), and the colorimetric method with ferric citrate (Wildenstein). Whenever tannin is estimated, it is advisable to state by what process the determination has been arrived at.

The Sugars.

These compounds belong to the group called carbohydrates, as they contain either six or some multiple of six carbon atoms, and twice as many hydrogen as oxygen atoms. They are very important compounds, and are widely disseminated throughout the vegetable kingdom. They are divided into three distinct groups, viz.: the glucoses $C_6H_{12}O_6$, the saccharoses $C_{12}H_{22}O_{11}$, and the amyloses $C_6H_{10}O_5$, the latter being not strictly sugars but starches.

The glucoses, $C_6H_{12}O_6$, are usually regarded as the aldehydes of a hexatomic alcohol, $C_6H_8(OH)_6$, but they also behave as pentahydric alcohols, $C_5H_6(OH)_5COH$, and some of them are regarded as possessing a closed chain as in benzene compounds, $C_6H_6(OH)_6$. Most of the glucoses are fermentable, a few only differing in that respect; they are also powerful reducing agents, quickly precipitating gold from its solutions, and discharging the colour of indigo-sulphuric acid. Many of them possess the power of twisting the ray of polarized light to right or left, and such are described as dextro or lævogyrate. This optical property of sugar is of great advantage, because by this means it is possible to determine what variety of sugar is present, and also the amount, in any substance.

Estimation of Glucose.—Amongst the numerous methods utilised for estimating glucose, Fehling's process stands first for accuracy and simplicity. The fermentation test is also used as a means of determining glucose, as well as the picric acid, the colorimetric method, and the gravimetric method of Mulder.

*Sugars.**Fehling's Volumetric Method.*

The Requisite Material is as follows :—

Fehling's Solution :—

Cupric Sulphate (in fine crystals).	34·64 gm.
Distilled Water	200·00 cc.
Dissolve.	
Potassio-Soda Tartrate.	200·00 gm.
Solution of Sodium Hydrate (1·2).	400·00 cc.

Dissolve and pour the alkaline solution into the copper solution, constantly stirring, finally dilute the whole to 1 litre. 10 cc. of this solution is equivalent to ·50 gm. of dextrose.

Process.—Measure 10 cc. of Fehling's solution into a white basin, and add 50 cc. of distilled water, now run in a little of the glucose solution, after which the contents of the basin are brought to the boiling point, the source of heat removed, and the glucose solution run in until the last trace of blue colour is discharged.

Reactions of Glucose.—Add to a little of the solution an alkaline solution of potassium picrate, and warm, when a dark blood-red colour is produced. A drop of indigo-sulphuric acid is added to the glucose solution, and then sodium carbonate until the liquid is alkaline. On boiling, the colour passes from blue to violet and finally disappears, but returns on shaking (Mulder). A few drops of caustic potash solution, added to solution of glucose, and warmed, turns brown (Moore).

To an alkaline solution of glucose a little bismuth oxynitrate is added, and the liquid is then boiled. The bismuth acquires a black or grey colour (Boettger). Solution of nitrate of silver, added to one of glucose, and then slightly warmed, turns brown, depositing silver (Maumène). If the solution be rendered alkaline with ammonia before warming, a metallic mirror will be produced (Tollen).

Starch, &c.

When solution of lead acetate is added, and then ammonia, after warming, the white precipitate turns a pale rose red colour (Schmidt).

The Saccharoses.—This class of sugar is closely related to glucose, being regarded as diglucosic alcohols. They differ chiefly from the glucoses in not being directly fermentable, but when treated with yeast they are mostly inverted, prior to conversion into alcohol, carbonic anhydride, and other products. When hydrolised with dilute sulphuric acid, saccharose yields one molecule of glucose and one of lævulose.

Estimation.—Saccharose may be estimated by means of the saccharometer, or by first inverting the sugar, and estimating as for glucose with Fehling's solution. The saccharimetric method is the one usually employed.

Reactions of Saccharose.—Saccharose, when treated as for glucose, gives negative results with Moore's, Fehling's, Boettger's, and Schmidt's tests.

To a little of the sugar dissolved in water add a minute particle of ox bile, and then some strong sulphuric acid; a play of colours is produced, varying from blood-red to violet purple (Pettenkofer). Saccharose readily chars with strong sulphuric acid.

The more important Sugars.

Dextrose.	} Glucoses.	Sucrose or Cane	} Saccharoses.
Lævulose.		Sugar.	
Inverted Sugar.		Lactose.	
Inosite.		Maltose.	
		Mycose.	

Starch. Dextrin and Cellulose.

Starch or Amylum, like sugar, is widely distributed in the vegetable kingdom, but is always in the form of microscopic granules. Starch is regarded as the oxygen ether of glucose, having the formula $C_6H_{10}O_5$, or more correctly, according to Musculus and others, $C_{18}H_{30}O_{15}$. Starch granules vary considerably in size (vide Amylum), form, and in the charac-

Starch, &c.

ter of the hilum. It is composed of two portions, viz., cellulose and granulose; the former gives a brown colour with iodine, and the latter strikes a deep blue. It is insoluble in cold water, but on boiling swells up, and forms a jelly; when boiled with dilute acids it hydrolises, and is converted into dextrin.

Estimation of Starch.—Dragendorff's process is the most satisfactory. It consists in digesting the substance in a 4 per cent. solution of caustic potash for two days at a temperature of 100° C. After filtering and well washing with spirit, and exhausting the residue with water, the remainder is washed with cold water, and boiled with dilute hydrochloric acid, the solution decanted, cooled, and precipitated with alcohol, and the precipitate collected, dried, and weighed.

Reaction of Starch.—When a cold decoction is largely diluted with water, it gives a deep blue colour on the addition of a solution of iodine. This is the most important and delicate test for starch.

The following bodies are closely related to starch: Hydrocellulose, Lichenin, and Gelose. The two latter gelatinize when boiled with water; the lichenin is soluble in Schibler's reagent, but gelose is insoluble, and is not so easily converted into sugar.

Inulin is the characteristic form of starch found in Compositæ. It is readily soluble in water at a temperature of 58° C. When hydrolised it yields lævulose and may be determined in this way.

Dextrin is a soluble modification of starch, which is found in certain vegetable structures. Closely related to this body is lævulin, sinistrin, and triticin. Dextrin is distinguished from the other three by yielding dextro-glucose; they, under similar treatment, yield lævulose.

Estimation.—The aqueous percolate is concentrated to a small volume, and a quantity of dilute alcohol added to precipitate mucilage and vegetable albumen, which is filtered off and washed, the filtrate and washings are concentrated, and four times its volume of strong alcohol added, the

Starch, &c.

precipitate collected, washed with strong alcohol, dried, and weighed.

Sinistrin and triticin are also precipitated on addition of hydrate of barium solution, a reaction that distinguishes them from dextrin and lævulin. If the precipitate is suspended in water, and a current of carbon dioxide passed through the solution, the carbohydrates are liberated from the compound, barium carbonate being precipitated. Instead of determining the dextrin gravimetrically, the precipitate is collected, hydrolised with dilute sulphuric acid, the acid removed by barium carbonate, and the resulting sugar determined volumetrically by Fehling's solution.

Cellulose.—This body, which is an isomer of starch, is the fundamental principle of plants, and is distinguished from most other constituents by its resisting the action of chlorate of potash and nitric acid, and chlorine water. Differences of chemical behaviour depend most likely only on the greater or lesser aggregations of molecules, as also on a more or less admixture with other bodies.

Estimation.—The residual mass, after being submitted to the action of various solvents, is finely powdered and macerated in freshly prepared chlorine water for three or four days, or until it ceases to lose weight, fresh chlorine water being added from time to time. It is then well washed and dried, the loss of weight generally indicating the proportion of lignin.

Reagents for Cellulose.—Schulze's solution, prepared by dissolving 8 parts of potassium iodide and 25 of zinc chloride in $8\frac{1}{2}$ of water, and then saturating with iodine.

Schibler's solution of ammonio-sulphate of copper is best prepared by first precipitating the hydrate of copper, collecting, washing, and dissolving in 20 per cent. solution of ammonia (Dragendorff).

Strong sulphuric acid and sirupy solution of chloride of zinc are also used as reagents.

The following compounds are closely related to cellulose :—

Gum and Pectin.

Pectose, which is easily converted by dilute acid into pectin.

Paracellulose, insoluble in Schibler's reagent until it has been treated with acids.

Metacellulose, insoluble in Schibler's reagent.

Cutose, insoluble in Schibler's reagent and sulphuric acid. Soluble in strong caustic potash.

Vasculose resembles cutose, but it is decomposed by chlorine water.

Cellulose is soluble in Schibler's reagent and in sulphuric acid.

GUM AND PECTIN.

This class of carbo-hydrates consists of combinations of feeble acids, such as arabic, with calcium, potassium, and other bases. They are formed in plants as degradation products, and give rise to two forms of mucilages, soluble and insoluble. Soluble mucilages form with water thick adhesive solutions, from which the gum is precipitated by alcohol. On prolonged boiling with dilute sulphuric acid they yield glucose. The glucoses resulting from different gums differ somewhat in their character, and by this means gums are distinguished from one another. Nitric acid yields several oxidation products with gums, the principal one being mucic acid.

Arabic acid is separated from the mucilages containing it by adding first dilute sulphuric acid, and then alcohol, which precipitates the arabic acid, or by pouring the solution into a dialyser, where it is left as a gelatinous amorphous mass.

Arabic, Metapectic, and Pectic Acids are closely related to one another, if not identical.

Pectin only differs from mucilage in some of its minor characters, and is most likely some modification of the same substance.

*Volatile Oils.**Reagents for Gum.*

Solution of neutral plumbic acetate.

Solution of basic plumbic acetate.

Nitric Acid. Sp. gr. 1.42.

Fehling's solution.

Strong alcohol.

VOLATILE OILS.

Essential or volatile oils are the proximate principles contained in plants, to which they owe, in a great measure, their characteristic odour. They are found in all parts of the plants, and very frequently a plant yields more than one volatile oil. On microscopical examination of thin sections of vegetable tissues, numerous cells appear to be filled with nothing but the volatile oil; but in many the volatile oil is contained in what are called receptacles of secretion, or in glands. The presence of such oils in tissues may result from metabolic changes, or from some peculiar phase of fermentation, or from the decomposition of glucosides, resins, or bodies of a similar nature. They possess no chemical, and but very few physical, properties in common with the fatty or fixed oils. Their specific gravity usually ranges between .84 and 1.2. They are generally soluble in alcohol, chloroform, ether, fixed oils, and carbon disulphide. When agitated with water they generally impart their characteristic odour and taste, but are only very slightly soluble in that menstruum. Volatile oils are all more or less inflammable, burning with a bright, but somewhat sooty, flame.

Extraction.—The process to be adopted for the preparation essentially depends upon the character of the drug to be operated upon. The following are a few of the methods used:—distillation, expression, enfleurage, and extraction by solvents.

Distillation.—This process may be carried on in two ways, the most simple consisting in first subdividing the drug, and then placing it in a copper, earthenware, or glass still,

Volatile Oils.

with water, or if the oil has a high boiling point, a solution of common salt is added. Direct heat may be applied, or the vessel may be heated with a current of superheated steam, and the distillation carried on until the aqueous distillate ceases to possess any odour of the drug. The distillate is allowed to stand for some time, after which the oil is decanted. The aqueous portion may be redistilled, collecting only the first portion which passes over; this, on cooling, yields a little more oil. The second method, which is one very suitable for the extraction of volatile oils from flowers and leaves, consists in passing a current of steam through the drug. This is a quick and easy process, and one of extreme value.

Expression.—This method is adopted in the preparation of volatile oils contained in the pericarp of fruits, as in the fruits of the Aurantiaceæ (*vide* Ol. Limonis).

Enfleurage.—This process for extracting volatile oils is carried on, on a large scale, in some European countries. A series of frames are first covered by a thin layer of pure fat, and then a layer of flowers placed upon the top; this is afterwards covered by another layer of fat, and the whole allowed to remain at rest for some time. The fat is then gently melted and strained, and the resulting pomade macerated in alcohol, which removes the volatile oil. Occasionally fluid fats are used in place of solid fats.

Extraction by Solvents.—This process is frequently employed in the analysis of drugs, when the quantity of the oil is so small that distillation would be troublesome and disappointing. Various solvents have been employed from time to time, one of the best being light petroleum ether. The petroleum ether solution of the oil is then placed in a double-necked bottle, and a current of dry, warm carbon dioxide passed through, which removes the ether, leaving the volatile oil.

Rectification.—When it is found necessary to rectify a volatile oil, this is best performed by mixing the oil with nearly its own weight of a fatty oil, and then distilling the mixture.

Volatile Oils.

Composition.—Essential oils vary considerably in their composition. They may be either a simple or a complex mixture, which may contain one or more of the following:—an aromatic acid, an aldehyd, an ethereal salt, a phenol, a neutral hydrocarbon, an oxygenated hydrocarbon, a sulphur compound, either as a sulphide or thiocyanate, a cyanogen compound as a cyanide, or a ketone. The majority of essential oils contain a neutral hydrocarbon, having the formula $C_{10}H_{16}$, or a multiple thereof. This hydrocarbon is commonly termed a terpene; these terpenes possess numerous isomeric modifications, the difference generally residing in optical properties, colour, odour, and boiling point. Accompanying the neutral hydrocarbon is usually found an oxygenated compound closely related to it. The oil thus consists proximately of at least two principles, which possess different boiling points.

Elæopten is that portion of an essential oil which has the lowest boiling point, and it is very frequently a hydrocarbon of the formula $C_{10}H_{14}$ or $C_{10}H_{16}$.

Stearopten is that portion of the oil which distils over last, and which usually solidifies at ordinary temperatures. It may have the formula $C_{10}H_{14}O$, $C_{10}H_{16}O$, or $C_{10}H_{19}OH$. It may frequently be separated from the oil by exposing it to a low temperature, when it crystallises out, or it may be removed from the oil by agitation with caustic soda solution. These stearoptenes generally possess in a marked degree the odour of the oil, but that from the otto of roses is odourless.

Sulphur may be detected in an essential oil by dropping a little of the oil on a mixture of sodium carbonate and potassium chlorate, and then making the whole into a thin paste with nitric acid. The mass is then digested in a water-bath for some time, afterwards dissolved in water, the solution acidulated with hydrochloric acid, and barium chloride added, when if sulphur be present a white insoluble precipitate will be thrown down. When the ethereal oil contains sulphur in the form of sulphide, mere agitation with caustic soda, and then an addition of nitro-prusside of sodium, is sufficient to produce a deep violet colour.

Volatile Oils.

Phenols.—When a phenol is present in an essential oil, it can be removed by agitation with caustic soda. When the solution is decanted and neutralised, the phenol can be determined by the use of ferric chloride, bromine water, and ammonia, or ammonia and hypo-chlorite of sodium.

Benzoic, salicylic, or cinnamic acids may occur in ethereal oils, either free or as salts of alcohols; they may be removed by agitation with a solution of ammonia, and the acid can then be recognised by its behaviour with ferric chloride, or by treatment with permanganate of potassium.

Aldehydes may be detected by the reducing action they have on an ammoniacal solution of silver nitrate. They are best removed by agitation with bisulphite of sodium solution, with which they form characteristic crystallisable compounds, and from which they are liberated by addition of caustic soda.

Fractionation.—When an essential oil is found to consist of two or more compounds it is always advisable to fractionally distil the oil and collect the distillate in separate fractions for further examination. By this means small quantities of what would otherwise be doubtful constituents are easily recognised.

Volatile oils, when kept for some length of time, undergo a kind of oxidation, their colour darkening, while at the same time they acquire an acid reaction. The odour and transparency of the oil may be restored by adding a small quantity of animal charcoal and borax, agitating for a short time, and filtering.

Reagents for Essential Oils.

Chloroformic solution of bromine (1 in 20).

Strong sulphuric acid.

Strong nitric acid.

Strong hydrochloric acid.

Fröhde's reagent.

Impure chloral hydrate.

Picric acid.

Iodine.

Sulphide of ammonium.

Essential Oil.	Chloroformic Bromine, 10 drops to 1 of oil.	Impure Chloral. 2 drops to 1.	Strong Hydrochloric Acid. 20 drops to 1.	Strong Sulphuric Acid. 3 drops to 1.	Ferric Chloride and Sulphuric Acid. Dissolve oil in CH Cl ₃
Bitter orange	Yellow ...	...	Yellow ...	...	Olive green
Cloves ...	Turning green...	Red on warming	Cherry red	Violet..	Green
Ginger ...	Turning green...				
Lavender ...	Turning green...	...	Brownish red	Red	
Rosemary ...	Red to violet ...	...	Cherry red	...	Green
Star anise ...	Red to violet ...	...	...	Red	
Cinnamon ...	Red to violet ...	Green ...	Rose red ...	{ Green to blue	
Peppermint ...	Red to violet ...	...	Red changing to blue	...	Red
Mace ...	Violet ...	Rose red	Reddish brown	Red	
Cubebs ...	Blue ...	...	Rose red ...	Red	Violet
Copaiba ...	Blue ...	Dark green	Rose red ...	Red	Violet
Sandal wood...	Blue ...	...	...	Red	
Nutmeg ...	Reddish violet ...	...	Reddish violet	Red	Green

Fixed Oils.

The foregoing are a few only of the reactions given by the reagents, but will serve to illustrate the value of such reagents.

Adulterations.—Essential oils are all more or less liable to adulteration. Amongst the chief adulterants used are alcohol, salicylic acid, fixed oils, oleo-resins, cheaper essential oils, phenol, chloroform, turpentine, and fusel oil. The adulterations have been treated in detail under the respective oils.

Fixed Oils.

Fixed or fatty oils are found in many plants, but their distribution throughout the plant is much more restricted than that of essential oils. Fatty oils are usually found in seeds, and to a less extent in roots, branches, and leaves. Unlike the volatile oils they are compounds of more simple character, consisting chiefly of ethereal salts of the radical glyceryl. The principal acids found in combination with that base are oleic, palmitic, stearic, and a number of the lower members of the fatty series. Microscopical examination of vegetable tissues soon betrays the presence of fat globules, by their high refractive power, as also by their behaviour with such solvents as petroleum ether, bisulphide of carbon, and solution of sodium hydrate. Fatty oils differ from volatile oils in not distilling when heat is applied; they usually darken in colour, and finally undergo decomposition, at the same time emitting strong offensive odours. When treated with solution of alkaline hydrates they form soaps, from which the fatty acid can be recovered.

Extraction.—Numerous methods are used to extract the fats contained in plants, the process depending essentially on the character of the fat, cold pressure being sufficient in some cases, but in others the fat is best obtained by pressure between hot plates. For a complete determination of the fat nothing is so satisfactory as exhaustion by percolation with a solvent such as petroleum ether. After

Fired Oils.

exhaustion the ether is removed by evaporation on a water-bath, and the residue dried at 212° F. until it ceases to lose weight.

Fatty oils are usually classed into two groups, viz., drying and non-drying.

Drying oils are those that on exposure to the air rapidly absorb oxygen, and form a characteristic varnish, such as linseed oil, this change being due to the peculiar modification of oleic acid called linoleic acid. Non-drying oils, on the other hand, do not possess the property of rapidly absorbing oxygen, and remain perfectly fluid on exposure to the air.

Determination of Melting Point.—The process for determining the melting point of fats or fatty acids is one of extreme simplicity. Several methods are adopted; the following two are easy of execution, and give fairly concordant results.

No. 1. Place a small piece of the fat on the surface of some mercury contained in a test tube, and introduce the bulb of a thermometer into the mercury. Now place the tube into a beaker of cold water and apply a gentle heat, and note the reading on the thermometer when the fat becomes perfectly clear.

No. 2. Draw some of the melted fat up a capillary tube, and allow one globule of the fat to congeal at the point, place this small tube, previously attached to a thermometer, inside an empty test tube, surround this with cold water, apply a gentle heat, and note the temperature at the moment the globule falls off, this will indicate the melting point.

Determination of Fatty Acids.—A weighed quantity of the fat is completely saponified with caustic potash, and the soap decomposed with dilute sulphuric acid, the separated fatty acids being collected when cold, and gently dried. As this residue of fatty acids may contain volatile fatty acids, it is mixed with water and distilled, the distillate neutralised with caustic soda, evaporated, and again decomposed with dilute sulphuric acid, the separated volatile fatty acids

Fixed Oils.

collected and weighed. The non-volatile fatty acids may be separated by dissolving them in alcohol and fractionally precipitating them with magnesium acetate and ammonia.

Determination of Glycerine.—After the saponification of the fat the soap should be precipitated by the addition of brine, and an aliquot portion of the clear filtrate taken and concentrated, then treated with absolute alcohol, and the solution decanted and carefully evaporated. A more correct method is to titrate the glycerine in solution with bichromate of potassium.

Adulteration.—Fixed oils are always liable to admixture with other oils of an inferior character; to such an extent has this system of adulteration been carried that it has become difficult to procure some classes of oils in a state of purity. Amongst the very numerous tests recently employed is the power of the oil to absorb iodine and bromine, Maumène's sulphuric acid reaction, and the Elaidin reaction.

Maumène's test consists in mixing 50cc. of the oil with 10cc. of strong sulphuric acid and noting the increase of temperature. Drying oils give a much higher reading than non-drying oils, as the following will show:—

Linseed ... from 14° to 133° C.

Almond ... ,, 14° ,, 59° C. (Casselman).

The Elaidin reaction consists in heating together a little of the oil with some mercury and nitric acid or acid solution of nitrate of mercury, and noting the colour and consistency of the residue. Instead of the above the oil may be mixed with an equal quantity of nitric acid, and the mixture warmed and then set aside, and the colour and consistency noted.

Amongst other reagents used are hydrogen peroxide, bisulphide of calcium, sulphuric acid, stannic chloride hydrochloric acid and sugar, and chloride of antimony.

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